DRAFT
REMEDIAL INVESTIGATION FEASIBILITY STUDY (RI/FS) WORK PLAN

ASHLAND/NSP LAKEFRONT SUPERFUND SITE

ASHLAND, WISCONSIN

August 2003

URS

URS
5250 East Terrace Drive, Suite I
Madison, Wisconsin 53718

URS Project No. 05644-098

NSP/Ashland Lakefront Site – BRRTS# 02-02-000013

URS

August 22, 2003

Mr. Jon Peterson
United States Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

RE: Draft Remedial Investigation/Feasibility Study Work Plan
Ashland/NSP Lakefront Superfund Site
BRRTS# 02-02-000013
URS Project No. 05644-098

Dear Mr. Peterson:

Please find enclosed three copies of the Draft Remedial Investigation/Feasibility Study (RI/FS) Work Plan for the Ashland/NSP Lakefront Superfund Site. This Work Plan is being submitted in accordance with ongoing discussions regarding the Administrative Order by Consent/Statement of Work (AOC/SOW).

Please call us at (608) 244-5656 should you have any questions or comments.

Sincerely,

URS Corporation

Albert W. Cole
Project Director

cc: Jerry Winslow
Dave Donovan
Dave Trainor
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List of Abbreviations

ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society of Testing Materials
BETX	Benzene, Ethylbenzene, Toluene, and Xylene
bgs	below ground surface
BTU	British Thermal Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
ch. NR 140	WAC Chapter Natural Resources 140 - Groundwater Quality
ch. NR 720	WAC Chapter Natural Resources 720 - Soil Cleanup Standards
ch. NR 722	WAC Chapter Natural resources 722 - Standards for Selecting Remedial Actions
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
COPCs	Compounds of Potential Concern
CSTAG	Contaminated Sediment Technical Advisory Group
CTE	Central Tendency Exposure
D&M	Dames & Moore Inc.
DCOM	Wisconsin Department of Commerce
DHFS	Department of Health and Family Services - State of Wisconsin
DNAPL	Dense Non Aqueous Phase Liquid
DW	Dry Weight
DQO	Data Quality Objective
EPA	Environmental Protection Agency (USEPA)
ERA	Ecological Risk Assessment
ERM	Effects Range - Median
EIS	Environmental Impact Statement
ES	Enforcement Standard per Wisconsin Administrative Code ch. NR 140
FS	Feasibility Study for Remedial Action Options
GLI	Great Lakes Initiative
HA-28	*Hyallela azteca* 28 day Toxicity Test
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
IRIS	Integrated Risk Information System
LNAPL	Light Non Aqueous Phase Liquid
mg/kg	milligram/kilogram
mg/l	milligram/liter
MGP	Manufactured Gas Plant
MSL	Mean Sea Level
NAPL	Non Aqueous Phase Liquid

NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NET	Northern Environmental Technologies, Inc.
NOAA	National Oceanic and Atmospheric Administration
NOC	Normalized to Organic Carbon
NSE	No Standard Established
NSP	Northern States Power Company
OMM	Operations Maintenance and Monitoring
ORNL	Oak Ridge National Lab
PAH	Polynuclear Aromatic Hydrocarbons
PAL	Preventive Action Limit per Wisconsin Administrative Code ch. NR 140
PE	Professional Engineer
PEL	Probable Effects Level
PG	Professional Geologist
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
RAOR	Remedial Action Options Report
RCL	ch NR 720 Residual Contaminant Level
RCRA	Resource Conservation and Recovery Act
RME	Reasonable Maximum Exposure
SEH	Short Elliott Hendrickson Inc.
SVE	Soil Vapor Extraction
TBC	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TPAH	Total Polynuclear Aromatic Hydrocarbons
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
TU	Toxic Units
µg/kg	microgram/kilogram
µg/l	microgram/liter
USEPA	United States Environmental Protection Agency
UV	ultraviolet
VOC	Volatile Organic Compound
WAC	Wisconsin Administrate Code
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollution Discharge Elimination System
WWTP	Wastewater Treatment Plant

EXECUTIVE SUMMARY

The Ashland NSP Lakefront Superfund Site (the "Site") consists of approximately 20 acres of affected land located on the shore of Chequamegon Bay of Lake Superior, in Ashland, Wisconsin. The Site contains property owned by Northern States Power Company, a Wisconsin corporation (d.b.a. Xcel Energy, a subsidiary of Xcel Energy Inc. ("NSP")), a portion of Kreher Park[1], a City owned property fronting on the bay, the former City Waste Water Treatment Plant (WWTP), also located at Kreher Park, and an inlet area containing contaminated sediment directly offshore from the former WWTP. The NSP property, located on an upland area above a bluff face fronting on Kreher Park, was the site of a former manufactured gas plant (MGP) that operated between 1885 and 1947. Kreher Park includes reclaimed lands from the bay filled during the late 1800s when the area was the site of major lumbering operations. The most significant of these operations was the John Schroeder Lumber Company, which operated a sawmill, a planing mill, a wood treatment facility and a shipping facility on the lakefront between 1901 and 1939. Filling of this area continued into the 1940s and 1950s when Kreher Park received municipal and industrial wastes during the City of Ashland's ownership.

The site includes four operable units (OUs). These include: OU 1, a filled ravine on the NSP property that formerly opened to the lakeshore prior to the filling of the present Kreher Park; OU 2, a deep confined aquifer, the Copper Falls, separated form the near surface fill soils by the Miller Creek Formation, a silty clay aquitard; OU-3, Kreher Park and the former WWTP; and OU-4 the affected offshore sediments. The primary contaminants at each operable unit are coal tar/creosote like compounds, volatile organic compounds (VOCs), and poly aromatic hydrocarbons (PAHs). The most abundant contaminants from each of these compound groups include benzene and naphthalene. Soils and groundwater contaminated with these compounds are present at OUs 1 and 3. In addition, free-product coal tar present as a dense non-aqueous phase liquid (DNAPL) is found in the upper reaches of the ravine on the NSP property, and at Kreher Park where an underground clay tile that extended the length of the ravine intermittently discharged to the surface at the "seep" area of the Park. Free-product coal tar is also found in the upper deposits of the Copper Falls Aquifer (OU 2). This free-product has resulted in a dissolved

[1] Reference to this portion of the Site as Kreher Park developed colloquially over the course of this project. Kreher Park consists of a swimming beach, a boat landing, an RV park and adjoining open space east of Prentice Avenue, lying to the east of the subject study area of the Site. For purposes of this work plan and to be consistent with past reports referenced in this plan, the portion of the Site to the west of Prentice Avenue, east of Ellis Avenue and north of the NSP property is referred to as the "Kreher Park Area" or simply Kreher Park.

phase plume that extends north from the area of the free-product in the direction of groundwater flow, beyond the shoreline of the Bay. However, the Miller Creek aquitard prevents cross-contamination from OU 2 to OU 3 and OU 4. Free-product is also present in the sediments. The area of affected sediments covers approximately nine acres. It is within these sediments where the highest contaminant levels of VOCs and PAHs have been found.

The Wisconsin Department of Natural Resources (WDNR) began formally investigating the Site in 1994. The Agency formally notified NSP of its responsible party status in 1995. Since that time, NSP has performed several subsurface investigations of OUs 1 and 2. The company has also implemented interim remedial actions for both of these operable units. A low-flow product removal system is currently extracting free-product from the Copper Falls Aquifer, and treating the entrained groundwater prior to discharge to the City's sanitary sewer. Additionally, NSP installed an extraction well at the base of the filled ravine near its former mouth to prevent contaminated groundwater from continuing to migrate from the ravine to the Kreher Park area. This well collects groundwater and discharges it to the existing coal tar recovery and treatment system. The installation of this extraction well was part of a larger interim action that included excavation of contaminated materials at the seep area and placement of a low-permeability cap to eliminate the intermittent seep discharge.

The WDNR has also investigated the Kreher Park area and the affected bay sediments. Parts of these efforts have included preparation of Human Health and Ecologic Risk Assessments (HHRA and ERA) on these affected areas. The primary conclusions of these studies have been that the contamination at the lakefront causes an unacceptable risk to human health and the environment. The WDNR has also concluded that the primary source of the contamination is the former MGP. NSP has presented additional information including eyewitness and deposition testimony, historical documentation and technical data that confirm the presence of Schroeder Lumber's wood treatment operations. However, the WDNR has not acknowledged the validity of this information.

During the execution of these studies by both the WDNR and NSP in 1999, a citizen petitioned USEPA to consider scoring the Site for inclusion on the National Priorities List (NPL). The Site was nominated for inclusion on the NPL in December, 2000, and formally listed in September 2002. During the listing period, USEPA entered into a Cooperative Agreement with WDNR to fund the RI/FS that is required as part of the NPL process. Subsequently, a series of technical meetings were held during the fall and winter of 2002/2003 among representatives of the two agencies and NSP to discuss plans to complete the RI portions of the program. (The only investigatory work that has been completed to date as part of these efforts was sediment sampling by the WDNR during March 2003.) During this same time, NSP began discussions with USEPA and WDNR regarding work that NSP was prepared to implement. Subsequently, following discussions with USEPA in May and June 2003 NSP was informally notified that USEPA would seek that NSP enter into an Administrative Order on Consent (AOC) for performance of the RI/FS work at the Site. The formal General Notice letter and proposed AOC with an attached Statement of Work (SOW) was received by NSP on August 8, 2003. The draft SOW refers to work products that the WDNR is currently in the process of preparing as part of its Cooperative Agreement with USEPA

The scope of work described herein for OUs 1, 2 and 3 is consistent with the agreements reached at the previously described technical meetings. These include the following:

- Preparation of site specific plans including a Site Management Plan, a Pollution Control and Mitigation Plan, a Waste Management Plan, a Health and Safety Plan, a Quality Assurance Project Plan, a Field Sampling Plan, and a Data Management Plan all following approval of the final RI/FS Work Plan;

- Collection of soil samples from borings advanced in the vicinity of the former MGP to further characterize the lateral and vertical extent of contamination at OU-1 south of St. Claire Street;

- Installation of additional piezometers in the Copper Falls aquifer, and collection of subsequent groundwater samples, to further characterize the lateral and vertical (in particular to determine if bedrock is affected) extent of groundwater contamination at OU-2;

- Conduct an air emission investigation to evaluate the potential inhalation pathway for exposure to potential hazardous vapors generated at the Site;

- Conduct a borehole geophysical survey to verify subsurface geologic units, and perform a visual (down hole camera) inspection of two artesian wells at Kreher Park;

- Conduct exploration test pits at OU-3 to characterize the limits of the uncontrolled solid waste disposal area and former wood treatment/coal tar "dump" area.

- Collect soil samples from borings advanced at Kreher Park in the vicinity of the former seep area, the former solid waste disposal area, and former wood treatment area to further characterize the lateral and vertical extent of contamination at OU-3.

- Install additional monitor well at Kreher Park, and collect additional surface water (groundwater infiltration into the former WWTP) and groundwater samples to further characterize the lateral and vertical extent of groundwater contamination in OU-3;

The investigation of OU ~~4 will be largely dependent on the results of the WDNR work products.~~ The March 2003 sampling data has only recently been made available. In addition, WDNR's proposed OU 4 Problem Formulation for Ecological Risk Assessment is currently being prepared, and is not scheduled for release until September, 2003. Regardless, NSP's approach to investigating this operable unit includes:

- Complete field investigation and modeling for OU-4 that will, based upon the March 2003 site investigation data, include:

    i. confirmation of the vertical limits of contamination;
    ii. identification of areas to conduct ecological testing;
    iii. performance of PAH forensic analysis on sediment samples; and
    iv. establishment of representative background and "ambient conditions" values for site compounds of potential concern (COPCs).
- Complete a baseline problem formulation, finalize the data quality objectives and develop a supplemental sampling plan to complete data needs for OU 4. Data needs preliminarily identified to date include the following:

    i. pore water characterization;
    ii. comprehensive evaluation of the benthic community;
    iii. fish impact study;
    iv. potentially, a wildlife ingestion study;

v. preliminary evaluation of the sediment stability;
vi. evaluation of wood waste impact;
vii. evaluation of dissolved phase COPCs in the water column with undisturbed sediments, and an evaluation of dissolved phase and free product COPCs in the water column with disturbed sediments;
viii. 28-day lifecycle tests for benthic species with and without ultraviolet light;
ix. caged mussel toxicity and bioaccumulation; and
x. fish early life-stage bioassay.

Following completion of the RI, NSP will prepare a Data Evaluation Report. This will be followed by preparation of the HHRA and ERA documents. The RI Report will closely follow preparation of the HHRA and ERA, which in turn will be followed by a Remedial Alternatives Technical Memorandum. The results of this Memorandum will trigger a Treatability Study on promising technology if it is determined to be necessary. In that event, the schedule for preparation of the FS will be determined at that time. If a Treatability Study is determined not to be needed, preparation of the FS Report will follow the Remedial Alternatives Technical Memorandum.

This work plan incorporates historic information on the Site and details a scope of work consistent with the results of the technical meetings held during the fall 2002 and winter 2003. It conforms to USEPA guidance on the development of these work plans. Although it predates receipt of the WDNR's Cooperative Agreement work products, it has been prepared and is being submitted in advance of the signing of the AOC as a good faith effort to advance portions of the proposed field investigations at OUs 1 and 2. Accordingly, it is also being submitted along with a Quality Assurance Project Plan (QAPP) specifically addressing these OU 1 and 2 investigations, although a site-wide QAPP will be submitted in accordance with the schedule described herein. Although it is assumed that this draft will be revised to reflect any necessary input from the WDNR documents once they are available, it is intended that this early yet complete RI/FS work plan will advance the overall program schedule, to prevent any further delays.

1.1 SITE DESCRIPTION

The Site consists of property owned by Northern States Power Company, a Wisconsin corporation (d.b.a. Xcel Energy, a subsidiary of Xcel Energy Inc. ("NSP")), a portion of Kreher Park, and sediments in an offshore area adjacent to Kreher Park. The Site is located in S 33, T 48 N, R 4W in Ashland County, Wisconsin, shown on Figure 1. Existing Site features showing the boundary of the Site are shown on Figure 2. The location of existing wells and borings used to define subsurface conditions are shown on Figures 3 and 4.

The NSP facility is located at 301 Lake Shore Drive East in Ashland, Wisconsin. The facility lies approximately 1,000 feet southeast of the shore of Chequamegon Bay of Lake Superior. The NSP property is occupied by a small office building and parking lot fronting on Lakeshore Drive, and a larger vehicle maintenance building and parking lot area located south of St. Claire Street between Prentice Avenue and 3rd Avenue East. There is also a gravel parking and storage yard area north of St. Claire Street between 3rd Avenue East and Prentice Avenue, and a second gravel storage yard at the northeast corner of St. Claire Street and Prentice Avenue. A large microwave tower is located on the north end of the storage yard. The office building and vehicle maintenance building are separated by an alley. The area occupied by the buildings and parking lots is relatively flat, at an elevation of approximately 640 feet above mean sea level (MSL). Drainage from the NSP property is to the north. Residences bound the property east of the office building and the gravel parking area. Our Lady of the Lake Church and School is located immediately west of Third Avenue East. Private homes are located immediately east of Prentice Avenue. To the northwest, the property slopes abruptly to the Wisconsin Central Limited Railroad property at a bluff that marks the former Lake Superior shoreline, and then to the City of Ashland's Kreher Park, beyond which is Chequamegon Bay.

The impacted area of Kreher Park area consists of a flat terrace adjacent to the Chequamegon Bay shoreline. The surface elevation of the park varies approximately 10 feet, from 601 feet MSL, to about 610 MSL at the base of the bluff overlooking the park. The bluff rises to an elevation of about 640 feet MSL, which corresponds to the approximate elevation of the NSP property. The lake elevation fluctuates about two feet, from 601 to 603 feet MSL. At the present time, the park area is predominantly grass covered. A gravel overflow parking area for the marina occupies the west end of the property, while a miniature golf facility formerly occupied the east end of the property. The former City of Ashland waste water treatment plant

(WWTP) and associated structures fronts the bay inlet on the north side of the property. The impacted area of Kreher Park is bounded by Prentice Avenue and a jetty extension of Prentice Avenue to the east, the Wisconsin Central Limited (WCL) railroad to the south, the Ellis Avenue and the marina extension of Ellis Avenue to the west, and Chequamegon Bay to the north. The impacted area of Kreher Park occupies approximately 13 acres.

The offshore area with impacted sediments is located in an inlet created by the Prentice Avenue jetty and marina extensions previously described. For the most part, contaminated sediments are confined in the inlet bounded by the northern edge of the line between the Prentice Avenue jetty and the marina extension. Contaminated sediment levels fall off beyond this boundary. The affected sediments consist of lake bottom sand and silts, and are overlain by a layer of wood chips, likely originating from former lumbering operations. The chips layer varies in thickness from 0 to seven feet, with an average thickness of nine inches. The entire area of impacted sediments encompasses approximately nine acres.

The Site contains four affected areas commonly referred to as "operable units," which are shown on Figure 6. These include two operable units on the NSP property (the ravine fill and Copper Falls), the Kreher Park area, and the affected offshore sediments. The buried ravine is a former drainage feature that begins near the NSP administration building fronting on Lakeshore Drive, and deepens and widens to the north (see Figure 7). The mouth of the ravine opens to Kreher Park through the bluff face at the north end of the gravel storage yard. The maximum depth of fill in the ravine at the mouth is approximately 33 feet. The Copper Falls Aquifer is a confined, variably coarse to fine-grained sand (reworked glacial till) that underlies the entire Site (see Figure 5). The formation is overlain by the surficial Miller Creek Formation, which is a lacustrine clay to silt unit. At the NSP property, the Miller Creek has a maximum thickness of about 35 feet; the thinnest portion of the unit is at the mouth of the former ravine, at approximately four feet. The Miller Creek Formation is overlain by fill at the lakefront (Kreher Park) and at the buried ravine. The physical separation created by the Miller Creek formation lying between the buried ravine and the underlying Copper Falls Aquifer, and the separation of these units from Kreher Park and the offshore sediments, permits the operable unit designation.

1.2 SITE HISTORY

Historically, Chequamegon Bay has been utilized as a vital transportation route for the shipment of various materials to and from Ashland including iron ore, lumber, pulp, and coal. During the late 19th and early 20th centuries, Ashland was one of the busiest ports on the Great Lakes. In recent times, the shipping industry through the bay has declined because of the decline in the mining and lumber industries in the region.

The Kreher Park area is reclaimed land of which the south boundary defined the original lake shoreline. Beginning in the mid to late 1800's, this area was filled with a variety of materials including slab wood, concrete, demolition debris, municipal and industrial wastes, and earthen fill that created the land now occupied by the park. The filled area was used for lumbering and sawmill activities by a number of lumber companies, the largest and longest tenured of which was the John Schroeder Lumber Company ("Schroeder Lumber"). Schroeder Lumber occupied the property from 1901 until 1939, when Ashland County took title to the Site.

Schroeder Lumber's operations were extensive. Schroeder Lumber's "articles of incorporation" stated that one of the company's business purposes was to "...manufacture and deal in preservative chemicals, to own and operate wood preservation plants and plants for the manufacture and stillization of wood-byproducts, to explore and develop lands for gas, minerals, ores and oils, and to collect, work, use, and treat any timber and all forest and other vegetable products." Schroeder Lumber's Ashland plant was the company's <u>only</u> wood processing facility where it operated a sawmill, lath mill and planing mill. Schroeder Lumber's Ashland Sawmill/Wood Processing facility was described as "one of the largest and best equipped mills in the greater northwest." (Bell, 1998). Details of the Schroeder Lumber operation including the physical location of facility appurtenances were obtained from interviews and depositions of eyewitnesses, review of historic documents, as well as fire insurance (Sanborn) maps. This information indicates that an above-ground structure or structures used for creosote dipping or treatment of railroad ties, telephone poles and the like was located in the west-central area of the present Kreher Park area. Additionally, oil houses (the functions of which have not yet been definitively identified) were located in the east central part of Kreher Park as shown on Sanborn Maps.

Following Schroeder Lumber's tenure, Ashland County transferred title to the City of Ashland in 1942, which has owned the property since. During the 1940's and 50's, the City operated a waste disposal facility (landfill) on the present northwest portion of the property. Beginning in 1951, the WWTP was constructed, and operated as the City's sewage treatment facility until 1989. During the mid-1980's, the marina extension of Ellis Avenue was completed, which created more usable land to permit establishment of a marina with full service boat slips, fuel and dock facilities and a ship store. In 1989 during exploratory work to expand the WWTP into the Kreher Park area, soil and groundwater contaminated with creosote/coal tar compounds were encountered. The City notified the Wisconsin Department of Natural Resources (WDNR), and subsequently closed the WWTP, relocating the current facility a few miles away to the northeast. In 1994, the WDNR authorized Short Elliot Hendrickson (SEH) to initiate an investigation and evaluation of the area to characterize the extent of contamination in Kreher Park, which heretofore had been referred to as a creosote contaminated site.

A former Manufactured Gas Plant (MGP) was located at the NSP property. The former MGP building has been incorporated into the main service facility, a block long "U" shaped building on St. Claire Street. The former MGP building comprises the eastern one-third of the service facility. The former MGP operated predominantly as a manufacturer of water gas and carbureted water gas between 1885 and 1947. Fairly extensive records, including the Brown's Directories and company operating reports and ledgers provided a basis for calculation of total gas and residual tar produced by the plant during the period it operated.

Coal tars were produced as a normal co-product of gas manufacturing. Only three years of data is available concerning the disposition of the coal tar co-product material. However, operating records from those years indicate that, in addition to being burned on site for energy recovery, much of the tar was sold as was the national practice at the time.

During the early tenure of the MGP, the previously described buried ravine was not filled-in and trended north across the NSP property from Lake Shore Drive to the bluff overlooking the bay. Historic Sanborn Fire Insurance maps (Sanborn maps) indicate the ravine was filled from south to north. By 1909, the entire ravine was filled.

NSP has investigated its property through a series of investigations beginning in 1995. These investigations confirm that the ravine fill is a low permeability, mixed fill consisting of clays, cinders and rubble, with saturated conditions at depths varying from five feet below the service building, to about 20 feet at the north end of the gravel storage area. These investigations have also identified subsurface contamination resulting from historic MGP operations. Contamination exists as dissolved phase coal tar constituents in groundwater, and as "pools" of dense non-aqueous phase liquid (DNAPL) of coal tar by-product. Coal tar has been encountered at the base of the ravine and in the underlying Copper Falls Aquifer. In the ravine, coal tar varying from one to two feet in thickness is present at the base of the ravine from south of the service facility north to the area of St. Claire Street. In the upper Copper Falls Aquifer, coal tar has been encountered from south of the service facility north to the gravel parking and storage yard area north of St. Claire Street. NSP installed an interim action coal tar recovery system on its property to remove coal tar from the Copper Falls Aquifer during the summer/fall of 2000; the system became fully operational in January 2001. The coal tar recovery system consists of three extraction wells, an oil/water separator, and an on-site groundwater treatment system. Groundwater samples have been collected quarterly since the coal tar recovery system began operating, and results have been presented in progress reports. More than 5,000 gallons of coal tar has been removed, and nearly 750,000 gallons of contaminated groundwater has been treated between January 2001 and July 2003.

A distinct DNAPL pool varying in thickness up to five feet was present in the area around the seep located in Kreher Park just north of the mouth of the former ravine. A clay tile that discharged to the "seep" area (located north of the mouth of the buried ravine at the railroad)[2] was encountered at the base of the backfilled ravine during investigations completed between September and November 2001. Coal tar encountered in the shallow southern portion of the ravine near the former MGP building provides a source for contaminated groundwater flow, north through the former ravine into Kreher Park. However, the contaminant levels measured in wells screened in the ravine north of St. Claire Street are significantly lower than wells screened in the ravine south of St. Claire Street (where free-product coal tar is present), or at the seep. The buried clay tile likely behaved as a conduit for the migration of coal tar as well as contaminated groundwater. However, a significant portion of the clay tile was destroyed during the 2001 investigation activities.

[2] The seep area had been the location of intermittent groundwater discharge containing a sheen and occasional odor of coal tar, until NSP performed the seep removal interim action in 2002.

NSP performed a second interim remedial response during May 2002 to eliminate the seep area. Activities completed included the excavation of contaminated soil in the seep area, the placement of a low permeability cap over the seep area, and the installation of a groundwater extraction well installed at the base of the buried ravine. Contaminated groundwater collected near the mouth of the ravine via a fourth extraction well is conveyed to the on-site treatment system described above. (Figure 3 shows the location of the extraction wells, EW-1 through EW-4, and the treatment building located on the NSP property.)

1.3 REGULATORY FRAMEWORK

An initial evaluation by the WDNR in 1994 led the Agency to issue a responsible party notice to NSP in January, 1995.[3] NSP then authorized Dames & Moore (D&M), now URS, to begin a series of investigations at its property that year. At approximately the same time, the WDNR authorized SEH to investigate the Kreher Park area of the Site.

D&M/URS performed several investigations during the next several years to characterize the extent of contamination in the buried ravine and Copper Falls Aquifer. The interim actions performed on the Copper Falls and seep discharge described above resulted from these investigations. In addition, ongoing quarterly monitoring of groundwater in the Copper Falls Aquifer is performed as part of the routine operation, maintenance and monitoring on the coal tar removal system.

Under contract to the WDNR, Short Elliot Hendrickson, Inc. ("SEH") performed a series of investigations at the Kreher Park area of the Site and the bay sediments during this same period. Part of this work has included a human health risk assessment and ecological risk assessments, the later confined to the bay sediments.[4] Both the URS and SEH investigations have been performed in accordance with chs. NR 700, et. seq. Wisconsin Administrative Code (WAC).

[3] The City of Ashland and Wisconsin Central Limited Railroad (n.k.a. Canadian National) also received responsible party letters. The City received letters dated August 21, 1991 and November 20, 1997. Wisconsin Central Limited received a letter dated November 20, 1997.

[4] SEH performed two Ecological Risk Assessments, one in 1998 and again in 2001. The second resulted from a review of the first document by USEPA, which claimed that the first document was insufficient to establish effects concentrations because of a lack of representative data points. These comments mirrored URS's earlier review of the SEH 1998 report.

During 1998, NSP signed a Spill Response Agreement with WDNR to complete remedial action options reports (feasibility reports) on both its property and the Kreher Park/bay sediments areas. The later two operable units were evaluated as an alternative feasibility analysis to an SEH study performed for the WDNR, and issued in a December 1998 report. D&M/URS prepared two separate reports, one for the two operable units on the NSP property, and the other for the Kreher Park/bay sediments. Both reports were issued in March, 1999. NSP and WDNR subsequently began a process of technical discussions designed to result in a remedial action decision for the four operable units. In the Spring of 1999, a private citizen petitioned USEPA to evaluate and score the Site for possible listing on the National Priorities List (NPL), or "Superfund" list. Because of this petition, the WDNR and NSP discontinued further efforts toward the remedial action decision-making process.

The Site was proposed for listing on the NPL in December, 2000. During early 2002, USEPA and WDNR entered into a Cooperative Agreement to fund an evaluation of analytical data that had been developed to date, and to prepare a plan to complete all remedial investigation activities in accordance with National Contingency Plan (NCP) protocol. In 2002, the Site was also identified to be evaluated as part of the Contaminated Sediment Technical Advisory Group (CSTAG) program from USEPA headquarters in Washington, D.C.[5] During July 2002, representatives of CSTAG which included members from nine USEPA regions, met in Ashland to receive presentations from the stakeholders, and formulate recommendations for further study. CSTAG submitted a series of recommendations at approximately the same time the Site formally was listed on the NPL (September, 2002). NSP representatives met with representatives of USEPA and WDNR in October 2002 to request consideration of the CSTAG recommendations as part of the remedial investigation (RI) activities being formulated by WDNR at that time, and to suggest that certain data gathering and assessment activities planned by NSP be incorporated into the pending work.

A series of technical meetings were held during the fall and winter of 2002/2003 among NSP, WDNR and USEPA to discuss these RI activities. Because of seasonal weather access constraints and the need to meet the winter deadline for "ice-out," the first of these RI activities included supplementary sediment sampling on the bay sediments for further physical characterization of these sediments. In accordance with USEPA approval, WDNR implemented

[5] See OSWER Directive 9285.6-08, *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites.* (Feb. 12, 2002).

an investigation of the sediments during March 2003, to allow access supported by winter ice. Further RI work however, was not implemented. At this same time, NSP began discussions with USEPA and WDNR regarding work NSP was prepared to implement.

Following discussions held in May and June 2003, NSP was informally notified that USEPA will seek that NSP enter into an Administrative Order on Consent ("AOC") for performance of the Remedial Investigation/Feasibility Study ("RI/FS") at the Site. The formal General Notice letter and proposed AOC (with attached Statement of Work (SOW)) was received by NSP on August 8, 2003. This Remedial Investigation/Feasibility Study (RI/FS) Work Plan has been developed as part of the AOC/SOW currently being discussed between USEPA and NSP.

1.4 OBJECTIVES

The overall goal of the RI/FS process is to collect sufficient data to characterize the extent of contamination at the Site and provide a feasibility study for a range of potential remedial options leading to the USEPA's selection of a proposed remedial action for the Site. Additional site investigation data and historic site investigation data will be used to evaluate potential exposure pathways to review potential remedial alternatives protective of human health and the environment. Specific objectives of the RI/FS include the following:

- Identify hazardous substances released to the environment, and develop a list of these constituents of concern;
- Identify the vertical and lateral extent of coal tar present as DNAPL;
- Identify the vertical and lateral extent of soil and groundwater contamination at the Site;
- Identify potential migration pathways for constituents of concern;
- Identify potential receptors for constituents of concern;
- Use previously developed data of sufficient quality for site characterization, risk assessment, and selection of proposed remedial alternatives;

- Evaluate potential risk to human health and the environment; and,

- Develop a range of remedial alternatives to remedy potential threats to human health and the environment.

1.5 SUMMARY OF PREVIOUS INVESTIGATIONS

WDNR's contractor, SEH, produced several documents from 1995 through 1998. SEH concluded in its 1998 remedial action options report that the primary source of contamination at the property was caused by releases from the historic MGP.[6] This was based in part, on the following:

- The identification of MGP appurtenances such as former gas holders and storage tanks shown on historic Sanborn maps;

- The physiographic location of the MGP in relation to Kreher Park (on an up gradient bluff overlooking the park area);

[6] The SEH report provided the following:

> The variations in concentration and distribution of individual PAHs or VOCs are possibly attributable to different waste sources (e.g., MGP wastes vs. wood treatment waste), historic changes in production processes or waste disposal practices (e.g., MGP switching from coal carbonization to carbureted water gas process), or geochemical or biodegradation processes. . . . A potential additional source of contamination on the Ashland Lakefront Property is the material comprising the "Coal Tar Dump" depicted on a 1953 (sic) site drawing prepared by Greeley & Hanson. Whether the material located in this area is in fact coal tar, wood treatment residuals, or some combination of these wastes has not been determined. The potential also exists that wood treatment may have historically occurred at other locations on the Ashland Lakefront property. However, conclusive evidence of this has not been found to date.

See, Remedial Action Options Feasibility Study – Ashland Lakefront Property and Contaminated Sediments, SEH, December 1998) at pg. 17.

See also, Comprehensive Environmental Investigation Report, SEH (May 1997) at pgs. 19, 30-31.

- The identification of a former ravine that transected the MGP site and opened onto the park area during part of its operating life that may have been a pathway for contaminants; and

- The identification of a 2-inch diameter pipe on the former MGP property on Greeley and Hansen engineering drawings for the 1951 construction of the WWTP. This pipe, labeled by Greeley and Hansen as *"2" Tar to For. Dump,*[7] was shown in cross-section and plan view crossing beneath St. Claire Street, and appeared to align with and lead to the location of an area labeled as "waste tar dump" shown on the Greeley and Hansen drawings north of the former seep area at Kreher Park.

As previously described, D&M/URS investigated the NSP property to characterize the extent of contamination beginning in 1995. Additionally, historical research on the operation of the MGP was also performed. The findings of this work were described in the Supplemental Investigation and Remediation Action Options Report for the NSP property (March 1999). The salient information from this report as well as earlier studies is as follows:

- Releases of coal tar product occurred during the lifetime of the MGP. Dense non-aqueous phase liquid (DNAPL) was found in the form of coal tar contaminated soils at the base of the former ravine below the water table. The DNAPL is restricted to the area south of St. Clair Street below the current NSP service garage. DNAPL had not been found north of St. Clair Street in this geologic unit in the former ravine. However, DNAPL was present in the fill aquifer at a surface water seep, north of where the ravine opens onto Kreher Park.

- The MGP operated primarily as a manufacturer of water gas or associated derivatives from about 1885 to 1947. This process resulted in a lack of nitrogen containing compounds (e.g., cyanides, phenols) found at other gas plant sites that used coal carbonization methods;

[7] This dump area has been the focus of NSP's efforts to locate a reported creosote dipping structure during Schroeder Lumber's tenure. Note also that these historic engineering drawings developed for construction of the former WWTP show a buried culvert connecting the "Coal Tar Dump Area" to a swale which led to the subject inlet. This culvert may have been installed as an attempt to drain this area, which was a residual of Schroeder Lumber's wood treatment operations.

- The product consists primarily of coal tar residue. Other typical MGP by-products (purifier box waste, clinker waste, etc.) are not predominant. This is consistent with the MGP process discussed above;

- DNAPL is found in a confined aquifer below a clay unit (the Miller Creek formation) directly beneath the former MGP. This confined aquifer (the Copper Falls formation), does not have a hydraulic connection with the fill aquifer at Kreher Park;

- Groundwater discharges from the mouth of the former ravine onto Kreher Park; coal tar contamination is present in this groundwater, but at levels several orders of magnitude below what is measured either at up gradient wells south of St. Clair St., or at down gradient wells at Kreher Park;

- The ravine was backfilled with uncontrolled fill (clay, cinders, and brick) by 1909; and

- The alleged 2" Tar Pipe, as labeled by Greeley and Hansen post-hoc, was investigated during the fall of 1998. The Greeley and Hanson drawings, as well as NSP historical drawings, identified an underground pipe that began and ended on the LSDP property. No indication of it is shown on any drawings that depict conditions at Kreher Park. Additionally, the 1998 field investigation found an approximate 2" metal pipe along with two additional pipes that were known to transport propane below St. Claire Street. following closure of the MGP. A section of this pipe was analyzed by a metallurgical firm, Crane Engineering and Forensic Science in Minneapolis, Minnesota. Crane concluded that the pipe was manufactured between 1920 and 1940 and likely carried water, steam or compressed air. There was no physical indication or residue of hydrocarbon to suggest the pipe historically carried hydrocarbons; (i.e. coal tars or coal tar emulsions). Appendix C of the D&M/URS March 1999 Remedial Action Options Report for the Ashland Lakefront Site includes the Crane report.

Subsequent investigations of the buried ravine by URS in 2001 identified the former clay tile that was the likely source of the seep discharge. This clay tile was found at the base of the ravine from the seep along the entire ravine axis, leading to the area of the former MGP. The crushing/removal of short segments of the tile during the 2001 investigations, the installation of the extraction well at the base of the ravine on the north side of the gravel storage yard (at the former ravine mouth) in May 2002, and the installation of the low permeability cap at the seep has essentially eliminated further seep discharge to the surface.

As described above, NSP and the WDNR have made differing conclusions as a result of their respective investigations at the Site with regard to the sources of contamination. Regardless of these differences, there is little difference of opinion on the degree and extent of contamination in the four operable units. Further information on the nature and extent of these contaminants is discussed in Section 3.0

The following is a list of reports and related documents performed by SEH and others for the Kreher Park and Bay Sediments portion of the Site:

- *Environmental Assessment Report - City of Ashland WWTP Site* (Northern Environmental Technologies (NET), August 1989);
- *Report of Test Pits at the Ashland WWTP* (NET, September 1991);
- *Remedial Investigation Interim Report - Ashland Lakefront Property* (SEH, July 1994);
- *Existing Conditions Report - Ashland Lakefront Property* (SEH, February 1995);
- *Draft Remediation Action Options Feasibility Study - Ashland Lakefront Property* (SEH, February 1996);
- *Sediment Investigation Work Plan – Ashland Lakefront Property* (SEH, February 1996);
- *Sediment Investigation Report - Ashland Lakefront Property* (SEH, July 1996);
- *Comprehensive Environmental Investigation Report - Ashland Lakefront Property* (SEH, May 1997);
- *Supplemental Investigation Report - Ashland Lakefront Property* (SEH, March 1998):
- *Human Health Risk Assessment Exposure Assumptions* (SEH, March 1998);

- *Ecological Risk Assessment: Problem Formulation* (SEH,
- *Baseline Human Health Risk Assessment - Ashland Lakefront Property* (SEH, June 1998);
- *Ecological Risk Assessment - Ashland Lakefront Property Contaminated Sediments* (SEH, October 1998);
- *Remediation Action Options Feasibility Study - Ashland Lakefront Property and Contaminated Sediments* (SEH, December 1998)
- *Seep Investigation Work Plan* (SEH, February 2001);
- *Pipe Source Investigation & Fingerprint Sampling – DNR work plan and contracts* (SEH, May 2001);
- *Investigation, Interim Remedial Action Options & Design Report* (SEH, October 2001);
- *Phase I Environmental Site Assessment* (Mid-States Associates – MSA, October 2001);
- *Final Phase II ESA Work Plan* (MSA – December 2001);
- *Environmental Forensic Investigation of Subsurface Pipes containing tar residues near a former MGP in Ashland, WI* (Battelle, January 2002);
- *Ecological Risk Assessment Supplement* (SEH, February 2002);
- *Phase II Environmental Site Assessment* (MSA, June 2002);
- *Quality Assurance Project Plan (QAPP) Task Specific – OU #4 Winter 2003, Sediment Sampling RI/FS* (SEH, February 2003).

Dames & Moore/URS, the Gas Technology Institute and others have developed documents that include review comments on selected SEH reports, as well as documentation for NSP concerning the historic MGP site. The following is a list of key documents, submitted to the WDNR concerning the Site:

- *Summary of field work conducted 12/94 at the NSP facility* (Cedar Corporation, January 1995);
- *Final Report - Ashland Lakefront/NSP Project* (D&M, March, 1995);
- *Proposed Work Plan for Remedial Action Plan* (D&M, March 1995);
- *Site Investigation Report and Remedial Action Plan - Northern States Power* (D&M, August, 1995);
- *Alternative Containment Design* (D&M, August 1995);
- *Design Report, Bidding Documents, Plans and Specifications for Interim Remedial Action - Northern States Power* (D&M, August, 1995);
- *Supplemental Site Investigation Work Plan and Schedule* (D&M, April 1996);
- *SEH Draft Remediation Action Options Feasibility Study - Review Comments for Northern States Power Company* (D&M, May, 1996);
- *Supplemental Groundwater Investigation Final Report for Northern States Power Company* (D&M, August, 1996);
- *Proposed Work Plan – Deep Aquifer Investigation – Copper Falls Formation* (D&M September, 1996;
- *Copper Falls Aquifer Groundwater Investigation for NSP* (D&M, February, 1997);
- *Comments on Proposed Ecological Risk Assessment* (D&M, July 1997);

- *Aquifer Performance Test and Groundwater Monitoring Results for Northern States Power* (D&M, October, 1997);
- *Exploration Trench Activities and Findings (2-inch pipe report);* (D&M March 1998);
- *Aquifer Remedial Action Plan - Lower Copper Falls Formation for NSP* (D&M, April, 1998);
- *Comments to SEH Human Health Risk Assessment Exposure Assumptions* (D&M, April 1998);
- *Comments to SEH Supplemental Investigation Report* (D&M, April 1998);
- *Fencing Plan* (Dames & Moore, July 1998);
- *Supplemental Site Investigation Work Plan* (D&M, July 1998);
- *Examination of excavated pipe sample* (Crane Engineering, October 1998);
- *Comments to SEH Ecological Risk Assessment* (D&M, December, 1998);
- *Ecological Risk Assessment for the Ashland Lakefront Property* (D&M, March 1999);
- *Supplemental Facility Site Investigation and Remedial Action Options Evaluation Report prepared for Northern States Power, Ashland, Wisconsin* (D&M, March, 1999);
- *Remedial Action Options Feasibility Study – Final Report for the Ashland Lakefront Site, prepared for Northern States Power, Ashland, Wisconsin for NSP* (D&M, March, 1999);
- *PCB Testing Work Plan* (D&M, April 1999);
- *Supplemental PCB Site Investigation Results for the NSP Facility* (D&M, July 1999);

- *Supplemental Site Investigation Work Plan for the NSP Facility* (D&M, July 1999);

- *1999 Supplemental Site Investigation for the Northern States Power Facility, Ashland, Wisconsin* (D&M, October, 1999);

- *Fingerprint Analysis of Free Product Samples from MW-15 and MW-7* (Institute of Gas Technology (now Gas Technology Institute), November 1999;

- *Interim Design – Plans and Specifications for a Coal Tar Removal System at the NSP Facility* (D&M, March 2000);

- *Comparative Analysis of NAPL Residues from the NSP Ashland Former MGP and Ashland Lakefront Property (Kreher Park)* (IGT, March 2000);

- *Addendum to the IGT Report: Comparative Analysis of NAPL Residues from the NSP Ashland Former MGP and Ashland Lakefront Property (Kreher Park) – Comparative Analysis of Sediment Samples from the Chequamegon Bay near the Kreher Park Shoreline* (IGT, May 2000);

- *Interim Action Groundwater Monitoring Plan for the NSP Facility* (D&M, September 2000);

- *Interim Action O&M Report – Coal Tar Recovery System* (URS, February 2001);

- *Construction Documentation Report – Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, February 2001);

- *Progress Report #001 – Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, February 2001);

- *Second Addendum Comparative Analysis of Two Samples* (GTI, April 2001);

- *Third Addendum Comparative Analysis of 10 Sediment Samples from Chequamegon Bay* (GTI, May 2001);

- *Final Report – Sediment Sample Results, NSP/Ashland Lakefront, Ashland, Wisconsin, prepared for Xcel Energy* (URS, June, 2001);

- *URS Response to U.S. EPA Comments on the SEH's "Ashland Lakefront Property - Contaminated Sediments Ecological Risk Assessment"," and responses to TOSC comments to Dames & Moore's "Ecological Risk Assessment Ashland Lakefront Property" and to SEH's "Ashland Lakefront Property - Contaminated Sediments Ecological Risk Assessment."* (URS, June 2001);

- *Progress Report #002 – Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, July, 2001);

- *Revised Estimation of Tar (DNAPL) in Bay Sediments* (GTI, August 2001);

- *Work Plan to Perform Pipe Investigation – Buried Ravine – Clay Pipe* (URS, August 2001);

- *Progress Report #003 – Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, October 2001);

- *Air Monitoring Results from Pipe Investigation Conducted September 2001* (URS, December 2001);

- *Progress Report #004 – Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, December 2001);

- *Fourth Addendum: Analysis of 11 Liquid Samples and One Soil Sample from the Ashland Lakefront Site* (GTI, January 2002);

- *Final Report – Clay Tile Investigation, NSP/Ashland Lakefront, Ashland, Wisconsin, prepared for Xcel Energy* (URS, February 2002);

- *Work Plan for Piezometer Installation* (URS, January 2002);

- *Progress Report #005 – Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, February 2002);

- *Contingency Plan for Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, March 2002);

- *Seep Area Interim Action Work Plan and Report* (URS, April 2002);

- *Comments on the SEH Ecological Risk Assessment Supplement* (URS, May 2002);

- *Former Gas Holder Work Plan – Additional Piezometer Installation* (URS, May 2002);

- *Progress Report #006 – Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, June 2002);

- *Final Report – Seep Interim Action Documentation Report, Ashland Lakefront Site, Ashland, Wisconsin, prepared for Xcel Energy* (URS, August 2002);

- *Progress Report #007 – Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, September 2002);

- *Quality Assurance Project Plan – Ashland Lakefront Project* (URS, December 2002);

- *AOC Work Plan #1 – Supplemental Site Investigation & Piezometer Installation* (URS, January 2003);

- *Progress Report #008 – Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, January 2003);

- *Quality Assurance Project Plan Addendum – OU-4 Winter Sediment Split Sample Collection* (URS, February 2003);

- *"Straw Man" Baseline Problem Formulation for Affected Bay Sediments, prepared for Xcel Energy* (URS, March 2003);

- *Progress Report #009 – Interim Response Coal Tar Recovery System, Xcel Energy Facility, 301 Lake Shore Drive, Ashland, Wisconsin, prepared for Xcel Energy* (URS, May, 2003).

2.1 REGIONAL GEOLOGY AND HYDROGEOLOGY

Ashland is located in the Lake Superior Lowland Province, a sub province within the Northern Highland Province. These lowlands consist of a low plains developed on Late Precambrian aged sedimentary bedrock overlain by unconsolidated glacial deposits. The lowlands rise several hundred feet above the present level of Lake Superior as gently sloping plains that were covered by glacial lakes ancestral to Lake Superior.

The upper most geologic unit (excluding the anthropomorphic fill soils and debris) is the Miller Creek Formation. The Miller Creek Formation is described as a silty clayey unit that is laterally continuous, ranging in thickness from several feet up to 50 feet in the Ashland area. The Miller Creek is underlain by the Copper Falls formation, which includes glacial till and glacial outwash sediments. The Copper Falls is underlain by Precambrian sandstones of the Oronto Group. The thickness of this unit is unknown, but it is likely underlain by Precambrian basalt. Bedrock was not encountered during the greatest depth of any of the Ashland Lakefront Site investigations to date (160 feet). According to published geological maps (Skinner, 1974) the depth to bedrock at this Site is between 150 and 200 feet. Bedrock in the Ashland area consists of Precambrian sandstones. The dip on the bedrock-sediment surface is toward the southeast. This dip appears to be caused by a blind extension of the Douglas Thrust Fault interpreted to exist south of the City of Ashland.

Regional aquifers correspond to regional geologic units. The Copper Falls Formation is the principal regional aquifer in the Ashland area. However, Lake Superior is the potable water source for the municipal water supply for the City of Ashland. The regional direction of groundwater flow is north towards Lake Superior.

2.2 SITE GEOLOGY AND HYDROGEOLOGY

Geology in the vicinity of the Site includes three unconsolidated lithostratigraphic units. The Miller Creek Formation and the underlying Copper Falls Formation comprise two of these units. The third lithostratigraphic unit is the fill material used to backfill the former ravine beneath the NSP facility, and the fill material placed in the Kreher Park area. Fill material on both properties is underlain by fine-grained silts and clays of the Miller Creek Formation. These units are shown on the Geologic Cross-Section included as Figure 5.

The fill soils on both properties vary in thickness. The backfilled ravine dissects the Miller Creek Formation on the NSP property. The base of the ravine was encountered within approximately nine feet of the existing ground surface in the alley south the vehicle maintenance building, and up to 15 feet in the parking area of the maintenance building south of St. Claire Street. The ravine width narrows, but deepens north of St. Claire Street; the base of the ravine, along its axis, was encountered at depths between 20 and 33 feet below the existing ground surface north of St. Claire Street. The ravine fill unit consists of silty clay fill material mixed with ash, cinders, slag, and fragments of bricks, concrete, glass, and wood. Beneath Kreher Park, the fill soils range from 0 to about 10 feet in thickness. This fill material consists of fragments of bricks, concrete, glass, and waste wood. Generally, the Kreher Park fill is more coarse-grained and contains large fragments, compared to the finer-grained materials in the buried ravine. (Municipal waste was also placed in the northwest portion of Kreher Park.)

The Miller Creek formation, which comprises the bluff located at the south end of Kreher Park, is the uppermost stratigraphic unit underlying the fill at Kreher Park and the sediments in Chequamegon Bay. The Miller Creek formation is a low plasticity silty clayey unit. As previously described, the depth of the Miller Creek below the NSP property is approximately 35 feet. Because the ravine deepens to the north, the separation between the base of the ravine at its mouth and the underlying Copper Falls Aquifer is only about four feet. From this location north toward the bay, the Miller Creek thickens to about 40 feet before extending below the bay.

The formation grades from a high plasticity clay (CH) into a low plasticity silty clay (CL) or non-plastic silt (ML) with depth. Thin discontinuous silty sand lenses are also present within this unit. South of the MW-9A and MW-4A well locations on the NSP property, the Miller Creek formation grades into a silt and silty sand unit at the base of the backfilled ravine. The higher plasticity portions of the Miller Creek Formation were likely removed by erosion when the ravine was created.

The Copper Falls Formation underlies the Miller Creek Formation, and consists of granular, cohesionless material deposited by glacial melt waters. The depth of the Copper Falls was not fully penetrated during any of the investigations performed. The maximum depth of the Copper Falls encountered in any of the investigation borings was approximately 160 feet south of St. Claire Street at the MW-9C location. To the south, beneath the NSP facility, the Copper Falls consists of silty sands with discontinuous lenses of silty clay and silt. To the north, beneath

Kreher Park, the Copper Falls formation consists of outwash sediments (i.e., clean sands with occasional gravel intervals).

The ravine fill and Kreher Park fill material, Miller Creek, and Copper Falls lithostratigraphic units also behave as hydrogeologic units. The fill materials overlying the Miller Creek Formation at Kreher Park and in the ravine contain a saturated water table condition. These fill units behave as perched aquifers separated from the underlying Copper Falls aquifer by the Miller Creek aquitard. Typical of perched conditions, vertical gradients between the ravine aquifer and the shallowest piezometers indicate a wide range of downward flow conditions. The smallest downward gradient was observed at the MW-5/-5A interval, and strong downward gradients were observed at the TW-13/MW-13A interval.

A groundwater mound is present in the ravine fill south of St. Claire Street. North of St. Claire Street, the water table in the ravine is characterized by a fairly steep gradient that flows through the mouth of the former ravine into Kreher Park. Groundwater flow within the perched aquifer within the northern portion of the ravine is toward the northwest, which coincides with the ravine axis. The low permeability fill soils in the ravine are in (10^{-6} to 10^{-8} cm/sec) contrast to the wood waste/demolition waste materials at Kreher Park. The water table in the fill at the park is characterized by high permeabilities (0.1 to 10^{-5} cm/sec), but with a very flat gradient, consistent with similar filled in lake bottom lands.

At Kreher Park, the groundwater "seep" located north of the mouth of the backfilled ravine discharged water to the surface with variable flow, depending on rain events and seasonal conditions. The elevation of the seep was over five feet above the water table levels measured in MW-7, which is located immediately adjacent to the seep. This indicated that the seep was likely created by water discharging from a buried pipe. As described above, the buried pipe was subsequently located and the seep area remediated as part of the 2002 interim remedial response.

The Miller Creek Formations behaves as an aquitard separating the overlying perched fill aquifers from the underlying Copper Falls aquifer. The thickness of the Miller Creek varies, but as described above thickens north of the NSP property from Kreher Park toward the bay. South of St. Claire Street., the Miller Creek formation becomes cohesionless, with a greater abundance of coarse grained soils. This allows the Copper Falls to become unconfined south of the alley located between St. Claire Street. and Lakeshore Drive. In the vicinity of the former MGP and

Kreher Park, the Copper Falls aquifer is confined. Typical of a confining unit, strong to moderate downward vertical gradients were detected within the Miller Creek aquitard. Vertical gradients within the Copper Falls aquifer indicate strongly upward flow conditions. Strong upward vertical gradients have been observed at the MW-5B/-5C and MW-13A/-13B well nests on the NSP property. The vertical gradient measured at the MW-2 (NET) and MW-7 wells nest in Kreher Park also indicate that the vertical gradient in the underlying Copper Falls aquifer is strongly upward at these locations at the Park. The horizontal direction of groundwater flow in the Copper Falls Aquifer is toward the northwest.

2.3 STORM WATER AND SURFACE WATER SYSTEM

Storm water in the vicinity of the Site flows north towards Lake Superior. On the NSP property, the area occupied by the buildings and parking lots is relatively flat, at an elevation of approximately 640 feet above mean sea level. Drainage from the NSP property is to the north. To the northwest, the NSP property slopes steeply to the Wisconsin Central Limited Railroad property, and then to Kreher Park, beyond which is Chequamegon Bay. The Kreher Park area consists of a flat terrace adjacent to the Chequamegon Bay shoreline. The surface elevation of the park varies approximately 10 feet, from 601 feet mean sea level (MSL), to about 610 MSL at the base of the bluff overlooking the park. The bluff rises abruptly to an elevation of about 640 feet MSL, which corresponds to the approximate elevation of the NSP property. The lake elevation fluctuates about two feet, from 601 to 603 feet MSL.

Information provided by the City of Ashland's Department of Public Works indicates that the City had a combined storm and sanitary sewerage system until the early to mid 1980's. The storm sewer system was separated from the sanitary system at that time to reduce flow to the former WWTP. Presently, storm water discharges directly to Chequamegon Bay through a series of outfalls. The City reported several outfalls are present at the bluff face at Kreher Park, which discharge to swales at the park, which in turn discharge to the Bay. The city is currently installing a storm system upgrade to redirect storm water flow away from the Site.

2.4 NATURE AND EXTENT OF CONTAMINATION

2.4.1 Ravine Fill

The lateral extent of soil and groundwater contamination in the backfilled ravine has been characterized from borings advanced during previous phases of investigation, aerial photographs, and other historical information. Base maps showing the approximate ravine contours were created, and cross sections were also developed, which indicate the fill types and groundwater table elevations in the ravine. Isopach contours showing the thickness of the ravine fill, groundwater contours, and the lateral extent of groundwater contamination is shown on Figure 7.

Investigation results indicate that the former ravine dissects the fine grained low permeability Miller Creek formation. This unit is present in the sidewalls and at the base of the backfilled ravine, and behaves as a confining unit for the underlying Copper Falls aquifer. The ravine fill unit consists of silty clay fill material mixed with ash, cinders, slag, and fragments of bricks, concrete, glass, and wood. The volume of the fill in the former ravine is estimated at 29,400 cubic yards.

The highest levels of soil contamination were detected within several feet of the surface in the vicinity of the former MGP located south of St. Claire Street. Site investigation results indicate that soil contamination is limited to the former ravine. The fine grained low permeability Miller Creek formation restricts the vertical and lateral migration of contaminants. The concentrations of contaminants decline with depth at several sample locations. Low levels of soil contamination were detected in soil samples collected around the perimeter of the former ravine which indicates that the concentration of contaminants also decline laterally with distance from the former MGP. Regardless, residual contaminant levels (RCLs) listed in ch. NR 720, WAC, for arsenic and coal tar constituents (benzene, toluene, xylene, acenaphthene, acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, naphthalene, and phenanthrene) were exceeded in soil samples collected from the NSP property.

Groundwater samples collected from shallow wells screened in the shallow aquifer on the NSP property detected coal tar constituents (benzene, toluene, naphthalene, trimethylbenzene (total), and xylene (total), anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, naphthalene, and pyrene) above groundwater quality standards. Groundwater monitoring results for samples collected from wells screened in and around the backfilled ravine indicates that groundwater contamination in the shallow aquifer is limited to the former ravine. The highest concentrations of coal tar constituents were detected in samples collected from wells MW-4, MW-9, TW-13, MW-14, and MW-15 located within the groundwater mound south of St. Claire Street. Groundwater samples collected from well MW-5 indicate that groundwater contamination is also present within the backfilled ravine north of St. Claire Street. Samples collected from wells MW-1 and MW-2 indicate that groundwater contamination is limited to the base of the ravine in this area. Additionally, samples collected from perimeter wells MW-8, MW-10, and MW-11 screened in the Miller Creek Formation outside of the former ravine, and MW-6 screened at the head of the ravine south of the highest contaminant levels, also indicate that groundwater contamination is limited to the former ravine.

DNAPL has historically been encountered in wells MW-9, TW-13, and MW-15 screened in the backfilled ravine located in the vicinity of the former MGP. Several feet of DNAPL were measured in these wells after they had been installed. However, the thickness of DNAPL in these wells has declined since the interim response coal tar recovery system became operational. (Since the coal tar recovery system began operating, DNAPL thickness has been measured in Site monitoring wells quarterly concurrent with the collection of groundwater samples; DNAPL is then bailed from each well if encountered, and discharged to the on-site remediation system.)

2.4.2 Copper Falls Formation

The Miller Creek grades into a silt and silty sand unit at the base of the former ravine between wells MW-4 and MW-9. The lithologic change in the Miller Creek south of St. Claire Street likely allowed the vertical (downward) migration of coal tars into the underlying Copper Falls aquifer. Elsewhere, the fine grained low permeability Miller Creek restricts the vertical migration of contamination, especially toward the bay where the Miller Creek thickens. Groundwater monitoring results detected elevated concentrations of coal tar constituents in samples collected from wells screened within the Copper Falls aquifer, as well as confirmed the presence of DNAPLs. (Because all soil within the Copper Falls is below the saturated zone, all contamination within the aquifer is considered groundwater contamination.) Groundwater elevation contours, the lateral extent of DNAPL, and the lateral extent of groundwater contamination in the upper Copper Falls Aquifer is shown on Figure 8. The vertical extent of groundwater contamination in the Copper Falls Aquifer is shown on Figure 5.

The highest concentrations of coal tar constituents were detected in samples collected from wells MW-2B(NET), MW-4A, MW-5B, MW-7A, MW-13A, and MW-13B. The strong upward gradients observed in the confined Copper Falls aquifer has resulted in a plume in the Copper Falls that is deep near the source area, and laterally extensive down gradient from the source area. The upward gradients in the Copper Falls have "forced" these contaminants upward with the general northward flow of groundwater in this aquifer. Consequently, a mushroom shaped plume is present in the Copper Falls below the NSP property. Analytical data collected at various depths identified a deep column of contamination in the suspected area of the release, extending into the lower Copper Falls to an approximate depth of 120 feet below ground surface at the MW-9/MW-9A location. Although contaminants have also migrated laterally in the down gradient direction of groundwater flow, samples collected from wells screened in the lower Copper Falls aquifer indicate that contaminant concentrations decline with distance from the source area. Contaminant levels appear to decline laterally away from the former MGP facility. Elevated levels have been measured in deep wells at Kreher Park; however, no DNAPL has been measured beyond the upper bluff area in this aquifer. Additionally, two artesian wells east and northwest of Kreher Park have yielded no contaminants.

DNAPL was also encountered in wells EW-1, EW-2, EW-3, MW-2A/MW-2AR, and MW-13A screened in the upper Copper Falls aquifer, and in well MW-13B screened in the lower Copper Falls aquifer. Up to 20 feet of DNAPL were measured in well MW-13A, and several feet have been measured in the remaining wells. However, the thickness of DNAPL in these wells has declined since the interim response coal tar recovery system became operational. (As described above, since the recovery system began operating, DNAPL thickness has been measured in Site monitoring wells quarterly concurrent with the collection of groundwater samples; DNAPL is bailed from each well if encountered, and discharged to the on-site remediation system.)

2.4.3 Kreher Park

Kreher Park is characterized by varying levels of contamination in soils and groundwater. This contamination consists primarily of volatile organic compounds (VOC) and polynuclear aromatic (PAH) hydrocarbon compounds. Metals were also detected in soil and groundwater samples, likely resulting from characteristics of the fill material. Results of investigations completed at Kreher Park indicate that the park area was covered by a 1 to 2 foot layer of clean surficial soil overlying the contaminated fill which is comprised of soil mixed with slab wood and sawdust. VOC and PAH impacted soils at Kreher Park approximates the area of shallow groundwater contamination. PAH soil contamination generally begins near the shallow groundwater surface, and extends to the top of the Miller Creek Formation. Emulsified NAPLs as well as an area of DNAPLs (near the seep) in wells at the park were also identified in Kreher Park fill soils. Groundwater elevation contours and the lateral extent of groundwater contamination at Kreher Park are shown on Figure 9. This data is predominantly based on analytical results developed by SEH.

2.4.4 Chequamegon Bay Inlet

The lateral and vertical extent of contamination in the Chequamegon Bay inlet adjacent to Kreher Park has been identified during previous investigations. Contaminated near-shore sediments are located within the inlets created by the jetty extension of Prentice Avenue to the east, and the marina extension of Ellis Avenue to the west. Constituents of concern identified from previous investigations include VOCs and SVOCs characteristic of a coal tar/creosote origin. A layer of wood chips overlies native sediment throughout the study area. The wood chip layer varies in thickness from 0 to 6-feet, averaging about nine inches. Native sediment underlying the wood chip layer consists of interbedded layers of sand, silty sand, silt, and silty clay. The highest concentrations of VOCs and SVOCs were detected in soil samples collected near the former open sewer drainage swale at depths between 0 and 6 feet. Contaminants are present at deeper intervals, but the lateral extent of contamination at these deeper intervals is limited to isolated hot spot areas. The lateral extent of contamination consists of an area approximately 7 acres in size as shown on Figure 10.

During the winter of 2001, URS conducted a detailed study of the extent of sediment contamination to further refine work performed by SEH in 1996. The results of this study are included in URS report titled *Final Report – Sediment Sample Results, NSP/Ashland Lakefront, Ashland, Wisconsin, prepared for Xcel Energy* (June 1,2001). Contaminant distribution maps for VOCs and SVOCs for two-foot intervals between the sediment surface and a depth of 10 feet below the surface developed from this study are presented in this report in Appendix A.

During March, 2003, SEH under contract to the WDNR and with the approval of USEPA, collected additional data for physical characterization of the bay sediments. This data included dredged samples of the shallow sediments (0 to six inches) as well as additional background samples beyond the affected area. Results of this testing have only recently been released by WDNR.

3.1 TYPES AND VOLUME OF WASTE PRESENT

The type and volume of waste present at the Site are the result of historic activities on the NSP and Kreher Park properties. Waste includes fill material placed in the backfilled ravine on the NSP property, and fill material placed at Kreher Park. Additionally, contaminated soil, groundwater, and sediment resulting from the former MGP operations are present on the NSP property. Contaminated soil, groundwater and sediments resulting from MGP operations, historic waste disposal practices, and lumber treatment are present at Kreher Park. A summary of the type and volume of waste is as follows:

- In the ravine, the estimated volume of fill material on the NSP property is approximately 29,400 cubic yards. The maximum estimated volume of DNAPL within the ravine, based on an assumed thickness of DNAPL of 1.5 feet, an area of 4,000 ft^2 and a porosity of 25 percent, is 11,220 gallons. (This volume is based on measurements of DNAPL restricted to wells south of St. Claire Street. Recent measurements of tar north of St. Claire Street have been measured in MW-2R. See Section 3.4.1 for further information.)

- At Kreher Park, the SEH March 1999 Remedial Action Options Report (RAOR) states that the contaminated park area covers approximately 10 acres, and that there is a one to two foot layer of clean fill overlying the contaminated fill. The depth of contamination ranges from one to fifteen feet. The impacted fill is estimated at 150,000 cubic yards, and the volume of clean fill overlying the contaminated soils is estimated at 45,000 cubic yards. A free- product plume was historically measured at the seep, at the location of monitoring well MW-7. This plume was a separate, distinct source, which likely originated from a combination of coal tar migration along the former clay tile identified at the base of the ravine, as well as rail offloading of fuel materials known to have occurred at this location. Other free-product measurements have not been made in other monitoring wells at Kreher Park. Much of this contaminated material and associated soils were removed (along with well MW-7) during the seep interim action in 2002.

- The estimated volume of contaminated groundwater in the Copper Falls Aquifer, based on an average thickness of 40 feet, and an area of 480,000 ft^2 and 25 percent porosity, is 36 million gallons. The maximum estimated volume of DNAPL, based on an assumed thickness of DNAPL of 13 feet, an area encompassing approximately 8,600 ft^2, and a porosity of 25 percent, is 210,000 gallons.

- Estimated volumes of contaminated sediment have been prepared by SEH and Dames & Moore/URS. Based upon the conclusions of the SEH 1998 Ecological Risk Assessment an area of 410,000 square feet, or 9.4 acres, of impacted sediments has been identified. The SEH RAOR states that a wood waste layer of 9-inch average thickness is present over the contaminated sediments, and that the sediments vary from 0 to 7 feet of thickness over the property. The volume of contaminated sediments is estimated at 152,000 cubic yards, including approximately 4000 cubic yards of wood waste. In 2001 URS performed a sediment investigation that further characterized the vertical extent of contaminated sediments. The lateral extent of contamination identified within the first six feet of sediments was essentially similar to that estimated by SEH. However, the presence of contaminants at greater depths was limited to discernible hot-spots. The report (June 2001) of that work concluded that these findings should be considered as part of the remedial approach for this operable unit.

- Dames & Moore/URS prepared an estimate of the total quantity of gas produced during the operating life time of the MGP, and then subsequently derived the total estimated quantity of tar generated from those gas production values. Details of these estimates are included in a December 4, 1998 letter, which is included as an appendix to the March 1, 1999 D&M RAOR for the Ashland Lakefront Site. The estimated total tar quantity produced during the MGP's operating life was approximately 600,000 gallons. This volume was later corroborated by the Gas Technology Institute. The December 4th letter also quantified and referenced other volumes of tar disposition available from historic records provided by NSP. These other modes of disposition included tar sales and boiler fuel burning records. These volumes were peer reviewed and corroborated by the Gas Technology Institute – See, *Volumetric Estimates of DNAPL (Coal Tar) in the Environment and Total Tar Production from the NSP Former MGP Facility in Ashland, WI* (GTI, October 2000).

- Dames & Moore/URS also prepared an estimate of the volume of product present in the sediments, which was estimated at approximately 2 million gallons. GTI also independently confirmed a volume of 2.3 million gallons present in the sediment.

3.2 POTENTIAL CONTAMINANT EXPOSURE PATHWAYS

3.2.1 Human Exposure Pathways

Potential contaminant exposure pathways to humans includes ingestion of contaminated soil or groundwater, inhalation of vapors from contaminated soil or groundwater, and physical contact with contaminated soil, groundwater, surface water, sediment, or coal tar. Minimal exposure can be expected from contaminated soil and groundwater via the ingestion and physical contact exposure routes because these exposure pathways are not generally complete. Contaminated soil is located below relatively clean fill and/or pavements and structures, and groundwater is not a potable water source. Subsurface contamination on the NSP property is located beneath buildings and asphalt pavement beneath and south of St. Claire Street. North of St. Claire Street in the buried ravine and at Kreher Park, relatively clean fill soil overlies the more contaminated soil and fill materials. Potential exposure scenarios for these pathways include construction workers encroaching contaminated materials in excavation trenches in the backfilled ravine on the NSP property or at Kreher Park. Additionally, although groundwater in the vicinity of the Site is not utilized as a primary source of drinking water by the City of Ashland (the City municipal water supply is obtained from Lake Superior from an intake approximately 1,900 feet offshore of Kreher Park), two artesian wells screened in the Copper Falls Aquifer are located at Kreher Park. However, samples routinely collected from these wells indicate that the water is safe to drink.

Minimal exposure can also be expected from inhalation of vapors from soil or groundwater because migration pathways do not exist. As described above, clean fill, asphalt pavement and buildings overlie areas with contaminated soil. There are no buildings with basements currently occupied on either property overlying contaminated fill material and the shallow fill perched aquifers. (The former City of Ashland waste water treatment plant is built over contaminated fill material, but the building is currently vacant and not used.)

Because the underlying Copper Falls aquifer is confined, there is also no pathway for vapor migration from contamination in the aquifer; the low permeability Miller Creek formation behaves as a confining unit as well as a barrier vapor migration.

The remediation of the former seep area in 2002 has eliminated exposure to contaminated soil and groundwater previously discharged at that area. However, exposure to sediment and contaminated surface water in the Chequamegon Bay inlet adjacent to Kreher Park would occur if people were to swim or wade in this area. Currently, swimming, wading and fishing in the area are restricted, and the area is well marked with warning signs and buoys. Ecologic receptors including benthic organisms and fish are exposed to this contamination. Previous studies by SEH have asserted adverse exposure to benthic invertebrates, but these results have been questioned and are proposed for further study. Additionally, fish tissue analyses completed on specimens taken from Chequamegon Bay indicate that fish do not contain levels of site-related chemicals that are a health concern.

3.2.2 Ecological Exposure Pathways

Exposure pathways for ecological receptors include the following:

- Birds - ingestion of sediment, surface water, and food;
- Mammals- ingestion of sediment, surface water, and food;
- Fish - ingestion and direct contact with sediment and surface water;
- Reptiles and amphibians - ingestion and direct contact with sediment and surface water and ingestion of food;
- Aquatic invertebrates - ingestion and direct contact with sediment or surface water and ingestion of food;
- Aquatic plants - root uptake and direct contact with sediment and surface water; and,
- Phytoplankton and zooplankton – direct contact with surface water.

Aquatic invertebrates, including benthic, epibenthic, pelagic and planktonic invertebrates, may be exposed to chemicals in sediment and surface water through ingestion and direct contact or by absorption through their skin. They can also be exposed through their food. Aquatic plants potentially can absorb chemicals from sediment and surface water through their roots, leaves, or stems. Both aquatic invertebrates and aquatic plants can serve as a major exposure pathway to upper trophic levels since they are prey for fish, birds, and mammals; this is termed trophic (or food chain) transfer. Food chain transfer of chemicals is of concern primarily only for those chemicals that are bioaccumulative.

Amphibians and reptiles may be exposed to chemicals in sediment and surface water along the shoreline through ingestion, dermal contact, and by feeding on contaminated aquatic invertebrates. Exposure may occur during feeding, early development of eggs and larvae, or burrowing. Amphibians and reptiles also may be an exposure pathway to birds and mammals through food chain transfer, again subject to the qualifier of bioaccumulation.

Fish may be exposed to chemicals in sediment and surface water through ingestion, dermal contact, uptake through gills, and by feeding on aquatic plants, invertebrates, or smaller fish. Exposure may occur during feeding, spawning, or burrowing. Aquatic vertebrates also may be an exposure pathway to birds and mammals through food chain transfer, assuming bioaccumulation.

Birds and mammals may be exposed directly to chemicals in the sediment and surface water through incidental ingestion, dermal contact, and inhalation of particulates, although the latter exposure pathway will not be quantitatively evaluated. They may also be exposed indirectly through food chain transfer although as discussed previously, this exposure pathway is significant only for those chemicals that are bioaccumulative.

3.3 PRELIMINARY PUBLIC HEALTH IMPACTS

SEH's 1998 Human Health Risk Assessment (which was confined to Kreher Park and the bay sediments) concluded the following for potentially exposed human receptors:

- An unacceptable cancer risk existed for city workers from dermal contact with groundwater containing known carcinogens – for the entire Kreher Park site (both for current conditions at that time and for potential future site development);

- An unacceptable cancer risk existed for recreational children from dermal contact with surface soils – for the entire Kreher Park site (for potential future site development where subsurface soils could be potentially exposed at the surface);

- An unacceptable non-cancer risk existed for recreational children from dermal contact with groundwater containing non-carcinogenic contaminants – for the entire Kreher Park site (for future site development);

- An unacceptable cancer & non-cancer risk existed for all populations from dermal contact with seep water; an unacceptable cancer risk existed for city workers from ingestion and dermal contact with seep subsurface soils; an unacceptable cancer risk existed for trespassing adolescents from dermal contact with seep surface soils. (These conditions included both current settings at that time and future site development scenarios. However, the seep remedial action performed in 2002 has eliminated these potential conditions);

- An unacceptable cancer risk existed for all populations from dermal contact with sediments (both for current conditions at that time and for potential future site development conditions).

The Wisconsin Department of Health and Family Services has also advised the public to follow a fish consumption advisory for Lake Superior. However, this is based on non-site related contaminants from other sources.

3.4 PRELIMINARY IDENTIFICATION OF OPERABLE UNITS

As described earlier, the operable units identified at the Site include the soil and perched groundwater in the filled ravine (OU-1); contaminated groundwater in the Copper Falls Aquifer (OU-2); contaminated soils, fill and groundwater at Kreher Park (OU-3), and the affected bay sediments (OU-4). These operable units have been designated because the geologic conditions sufficiently vary, and the potential remedial responses will be distinct and possibly separate for each. A detailed description of each operable unit follows.

3.4.1 Ravine Fill (OU 1)

As described in Section 2.0 above, the former ravine dissects the fine grained low permeability Miller Creek formation. This unit is present in the sidewalls and at the base of the backfilled ravine. The Miller Creek formation is a low plasticity silty clayey glacial till, and behaves as a confining unit for the underlying Copper Falls aquifer. (The confined portion of the aquifer is north of the area of the alley that is located between and parallel to St. Claire St. and Lakeshore Drive, directly behind the NSP building.) The ravine fill unit consists of silty clay fill material mixed with ash, cinders, slag, and fragments of bricks, concrete, glass, and wood. The former ravine has been delineated from borings, aerial photographs, and other historical information, and is shown on Figure 7.

Results of previous phases of site investigation indicate that contamination is limited to the former ravine; the fine grained low permeability Miller Creek formation restricts the vertical and lateral migration of contaminants. Chapter NR 720, WAC, residual contaminant levels (RCLs) have been exceeded in soil samples collected from the backfilled ravine on the NSP property, and ch. NR 140, WAC, groundwater quality standards have been exceeded in groundwater samples collected from shallow wells screened in the perched aquifer in the ravine. DNAPL has also historically been encountered in wells MW-9, TW-13, and MW-15 screened in the backfilled ravine located in the vicinity of the former MGP. (The thickness of DNAPL measured in these wells has declined since active product removal has been performed as part of the coal tar recovery interim action.) During July 2002 and again in June 2003, DNAPL has been measured in MW-2R, located in the gravel storage area north of St. Claire Street.[8]

3.4.2 Copper Falls Aquifer (OU 2)

Groundwater monitoring results detected elevated levels of coal tar constituents in samples collected from wells screened within the Copper Falls Aquifer. The migration pathway for these contaminants was likely associated with a breach in the Miller Creek aquitard where the formation grades from a predominantly silt unit to a clay unit near the east-west alley behind the NSP service center. As previously discussed, from this area to the north, the Copper Falls becomes confined. This same area was also the site of a former gas holder, which was a likely source for these coal tar materials. The depth of fill at this location is more than 15 feet, which is east of the former ravine. (The maximum ravine depth to the west is approximately nine feet.) This depth may correspond to the depth of the holder's foundation excavation. A shallow monitoring well screened at the site of this former gas holder (MW-15) historically yielded thick tar measurements on the order of several feet when first installed; however, since the tar removal system has operated, tar is routinely removed from this well, and only a few inches are routinely measured during recent sampling events. Immediately north of this area, extending north to the MW-2 well nest, coal tar DNAPL has been measured in wells screened near the top of the

[8] MW-2R is a replacement well for MW-2, destroyed during investigation of the clay tile during Fall 2001. Coal tar had not been previously measured in well MW-2. These recent DNAPL measurements were potentially caused by the increase in permeability conditions of the ravine fill during excavation and backfill of the exploratory trenches advanced for this investigation. The source of this coal tar is likely that material identified south of St. Claire St.

aquifer. This free-product plume is the source of the dissolved phase plume that appears to extend beyond the shoreline at Kreher Park. However, also note that the Miller Creek aquitard effectively prohibits a connection between the contaminants in the fill at Kreher Park as well as the sediments in the bay and the Copper Falls Aquifer.

Analytical data collected at various depths has identified a deep column of dissolved phase contamination in the suspected area of the release, extending to an approximate depth of 120 feet below ground surface at the MW-9/MW-9A location. Contaminants have migrated down gradient with groundwater. The strong upward gradients observed in the confined Copper Falls aquifer has resulted in a plume in the upper Copper Falls that is laterally extensive. Figure 8 shows the lateral extent of groundwater contamination in the upper Copper Falls Aquifer. The highest concentration of coal tar constituents have historically been detected in samples collected from wells MW-2AR. MW-2B(NET), MW-4A, MW-5B, MW-7A, and MW-13A. Groundwater samples collected from wells screened in the lower Copper Falls Aquifer indicate that the lateral extent of contamination is not as extensive at depth. As shown on Figure 5, the highest concentration of coal tar constituents have historically been detected in samples collected from well MW-13B, where the thickest product measurements have been measured. The concentration of coal tar constituents have historically been detected at lower concentrations in samples collected from wells MW-2A(NET), MW-4B, MW-5C, and MW-9A screened deeper in the Copper Falls Aquifer.

3.4.3 Kreher Park (OU3)

As described in Section 2.0 above, Kreher Park is characterized by varying levels of contamination in soils and perched groundwater. Contamination consists primarily of VOCs and PAH compounds. Metals were also detected in soil and groundwater samples, likely resulting from characteristics of historic fill or landfilled material. Site investigation results indicate that contaminated fill is comprised of soil mixed with slab wood and sawdust, and is overlain by several feet of clean fill material. Contamination generally begins near the shallow groundwater surface, and extends to the top of the Miller Creek Formation. Emulsified NAPLs as well as an area of DNAPLs was also identified in the former seep area located at Kreher Park near the mouth of the backfilled ravine. Contaminated soil in this area was removed, and the intermittent groundwater discharge eliminated, as part of the interim response completed in the spring of 2002. The lateral extent of contamination for OU-3 is shown on Figure 9.

3.4.4 Chequamegon Bay Inlet Sediment (OU4)

As described in section 2.0 above, contaminated nearshore sediments are located within the inlets created by the jetty extension of Prentice Avenue to the east, and the marina extension of Ellis Avenue to the west. Constituents of concern identified from previous investigations include VOCs and SVOCs characteristic of a coal tar/creosote origin, as found in soils and groundwater at Kreher Park (OU-3). However, the concentration levels of contaminants in the lake sediments are higher than those found in samples collected at the park. These levels are generally higher than the solubility limits for the subject compounds, indicating that pure product is present in the sediments over a wide area. A layer of wood chips overlies native sediment throughout the study area. The wood chip layer varies in thickness from 0 to 6-feet. Native sediment underlying the wood chip layer consists of interbedded layers of sand, silty sand, silt, and silty clay. The lateral extent of contamination consists of an area approximately 9 acres in size as shown on Figure 10. Isoconcentration maps for VOCs and SVOCs for two-foot depth intervals from the sediment surface to a depth of ten feet, prepared for URS' June 2001 sediment investigation report, are included in Appendix A.

3.5 PRELIMINARY IDENTIFICATION OF RESPONSE OBJECTIVES AND REMEDIAL ACTION ALTERNATIVES

Potential remedial responses for OU-1 and OU-2 were evaluated in the March 1999 Supplemental Facility Site Investigation and Remedial Action Options Evaluation Report prepared for Northern States Power prepared by Dames & Moore/URS. In that report, Dames & Moore/URS evaluated each alternative with regard to its expected (i) long term effectiveness, (ii) short term effectiveness, (iii) implementability, (iv) restoration time frame, (v) cost, and (vi) potential future liability in accordance with ch. NR 722, Wisconsin Administrative Code (WAC). After completing any initial screening of options, the following five alternatives were selected for detailed evaluation for OU-1:

1) Remedial Alternative OU-1A--No Further Action;

2) Remedial Alternative OU-1B--Low Permeability Cap;

3) Remedial Alternative OU-1C--Barrier Wall, Low Permeability Cap, and Groundwater Pump & Treat;

4) Remedial Alternative OU-1D--Limited Excavation of Soils;

5) Remedial Alternative OU-1E--Six Phase Heating.

Similarly, four alternatives were evaluated for OU-2:

1) Remedial Alternative OU-2A--No Further Action;

2) Remedial Alternative OU-2B--Groundwater Pump and Treat;

3) Remedial Alternative OU-2C--In Situ Groundwater Circulation Wells;

4) Remedial Alternative OU-2D--Dynamic Underground Stripping Using Steam Injection.

A rating was assigned to each criteria, and an overall score for each alternative was calculated. Costs ranged from the least restrictive (No Action at $0) to the most restrictive (Steam Injection at $25 million). A low permeability cap with groundwater monitoring (OU-1B), at a 40-year capitalized cost of approximately $600,000, was the recommended remedial alternative for the ravine fill (OU-1). Groundwater pump and treat (OU-2B), at a 40-year capitalized cost of $3.25 million, was the recommended alternative for the Copper Falls aquifer (OU-2).

SEH evaluated potential remedial alternatives in a December, 1998 report entitled Remediation Action Options Feasibility Study (FS) for the Ashland Lakefront Property consisting of the Kreher Park property and the near-shore contaminated sediments. These alternatives were prepared for the entire Kreher Park and bay sediments areas. Remedial alternatives evaluated in that report included the following:

1) Option A – No Further Action;

2) Option B – Access Restrictions and Institutional Controls;

3) Option C1 – Engineering Controls with a Thick Soil/Sediment Cap;

4) Option C2 – Engineering Controls with An Armored Cap;

5) Option D1 – Breakwater/Cutoff Wall Installed around Entire Site/Filling of Contaminated Sediments Area/In-Situ Remediation;

6) Option D2 – Breakwater/Cutoff Wall Installed around Entire Site/Partial Filling of Contaminated Sediments Area/Dredging of Remaining Sediments/Confined Sediment On-Site Treatment Facility/In-Situ Remediation;

7) Option E1 – Excavation/Separation/Treatment/Backfill;

8) Option E2 – Excavation/Off-Site Disposal/Clean Backfill;

9) Option E3 – Excavation/Off-Site Disposal/No Backfill.

SEH rated the criteria and scored each alternative similar to the D&M/URS rating procedure. Costs ranged from $0 for No Action to nearly $90 million for Excavation and Off-Site Disposal with Clean Backfill. The best scoring options were the "D" series options. The 40-year capitalized costs for these ranged between $40 million (for D1) and $51 million (D2).

Dames & Moore/URS presented alternative remedial alternatives in its March 1999 RAOR for the Ashland Lakefront Site. The purpose of this alternative report was to fulfill the requirements of Paragraph 1(h) of the June 22, 1998 Spill Response Agreement between the WDNR and NSP. The alternative RAOR included: (1) a review of the December 1998 SEH report (Appendix A); (2) the application of SEH remedial standards for sediments, as well as Dames & Moore/URS remedial standards for sediments, to proposed sediment cleanup options (SEH remedial standards are based upon its October 1998 Ecological Risk Assessment (ERA); the application of Dames & Moore/URS remedial standards for sediments was based upon an alternative ERA submitted by Dames & Moore/URS under separate cover)[9]; (3) evaluation of applicable or relevant and appropriate requirements (ARARs); (4) identification and screening of potential

[9] These alternative standards were based upon an alternative method to establish an adverse effects concentration to benthic organisms proposed by Dames & Moore/URS. Although the results indicated a lower effects concentration using this method, it was later shown that a mathematical error caused this reduction. Once corrected, the effects concentrations using both the SEH method and the Dames & Moore/URS concentration were nearly the same. Regardless, the purpose of the alternative method was an attempt to use the existing SEH data from its 1998 Ecological Risk Assessment, which was insufficient. This was initially concluded by Dames & Moore/URS and later confirmed by USEPA.

remedial technologies; (5) detailed evaluation of selected technologies and a comparison of selected technologies, and (6) a recommendation for a remedial option based upon the foregoing.

The alternative study provided a detailed evaluation of nine targeted remedial alternatives, which ranged from a no action alternative, to capping of the sediments using partial bay filling along with an armored cap for the remainder of the affected sediments, and "hot spot" removal for source elimination, along with ozone sparging for groundwater remediation at Kreher Park. For comparison, SEH sediment cleanup limits and Dames & Moore sediment cleanup limits were evaluated separately. The list of evaluated alternatives include the following:

1) Option A - No Further Action;

2) Option B1 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Cap Sediments - SEH ERA Limits;

3) Option B2 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Cap Sediments - D&M ERA Limits;

4) Option C1 - Institutional Controls/Source Removal at Seep/Cap Sediments/ Ozone Sparge at Kreher Park - SEH ERA Limits;

5) Option C2 - Institutional Controls/Source Removal at Seep/Cap Sediments/Ozone Sparge at Kreher Park - D&M ERA Limits;

6) Option D1 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Partial Filling of Bay/Cap Sediments- SEH ERA Limits;

7) Option D2 - Institutional Controls/Source Removal at Seep/Institutional Controls on Groundwater/Partial Filling of Bay/Cap Sediments - D&M ERA Limits;

8) Option E1 - Institutional Controls/Source Removal at Seep/Partial Filling of Bay/Cap Sediments/Ozone Sparge at Kreher Park - SEH ERA Limits, and

9) Option E2 - Institutional Controls/Source Removal at Seep/Partial Filling of Bay/Cap Sediments/Ozone Sparge at Kreher Park - D&M ERA Limits.

As later shown, the D&M ERA limits were incorrect (see previous footnote No. 4). Regardless, a scoring system for each of the evaluation criteria described in ch. NR 722, WAC was developed for each alternative evaluated. The alternative that yielded the most desirable score was Institutional Controls/Source Removal at Seep/Cap Sediments/ Ozone Sparge at Kreher Park (C1/C2). However, NSP chose to recommend Institutional Controls/Source Removal at Seep/Partial Filling of Bay/Cap Sediments/Ozone Sparge at Kreher Park (E1/E2), an alternative with a higher score. Costs ranged from $0 for No Action to $15.5 million for Institutional Controls/Seep Removal/Partial Bay Filling/Cap Sediments/Ozone Sparge (E1). Cost was the only criterion that yielded a difference in scoring between the C series and E series scores, as all other criteria scored the same. As stated, the 4-year capitalized cost for the E1 option was approximately $15.5 million.

The Site has been the subject of several investigations since 1995. The nature and extent of geologic as well as contaminant conditions have been fairly well defined. Although supplemental sampling for OUs 1, 2 and 3 as described in this work plan will refine this understanding, the remedial actions that will be determined for OUs 1, 2 and 3 in the Record of Decision (ROD) for this Site will likely fall within the universe of options previously studied (see the previous Section 3.5). Accordingly, the work plan rationale and associated data quality objectives (DQOs) for the work proposed for these first three OUs are concise and straightforward. However, the agencies recognize that the previous risk assessment studies are deficient, and consequently, a formal DQO process and Problem Formulation particularly with regard to OU 4 are required to support both a Baseline Human Health Risk Assessment and Baseline Ecological Risk Assessment. NSP believes that the ongoing remedial investigation process and the future risk management decision-making will benefit now from a more formal and systematic integration of concepts introduced in the guidance for managing contaminated sediment sites (USEPA 2002) into the risk assessment process.

The results of the previous studies as well as the additional sediment sampling conducted this past winter (March 2003) provide an excellent basis for completion of both the DQO process as well as the Problem Formulation. To the extent USEPA considers it advisable, this process can include other stakeholders.

The following sections briefly describe the process completed to finalize the RI/FS Work Plan and provides NSP's recommendations for the studies needed to fill the data needs.

4.1 DATA QUALITY OBJECTIVES

4.1.1 The Data Quality Objective Process

The Data Quality Objective (DQO) process is described in USEPA guidance as "a seven-step planning approach to develop sampling designs for data collection activities that support decision making. This process uses systematic planning and statistical hypothesis testing to differentiate between two or more clearly defined alternatives". It is recommended by USEPA in RI/FS guidance (USEPA 1988) and ecological risk assessment guidance (USEPA 1997; 1998). The USEPA developed the DQO process "...as the Agency's recommended planning process when environmental data are used to select between two opposing conditions." A summary of the seven steps involved in the DQO process is presented in the table below (from USEPA 2000).

The Data Quality Objective Process

DQO Step	Activity
Step 1. State the problem.	Define the problem; identify the planning team; examine budget and schedule.
Step 2. Identify the decision.	State decision; identify study questions; define alternative actions.
Step 3. Identify inputs to the decision.	Identify information needed for the decision (information sources, basis for Action Level, sampling/analysis method.)
Step 4. Define the boundaries of the study.	Specify sample characteristics; define spatial/temporal limits, units of decision making.
Step 5. Develop decision rule.	Define statistical parameter (mean, median); specify Action Level; develop logic for action.
Step 6. Specify tolerable limits on decision errors.	Set acceptable limits for decision errors relative to consequences (health effects, costs).
Step 7. Optimize the design for obtaining data.	Select resource-effective sampling and analysis plan that meets the performance criteria.

The specific goals of the general DQO process are to:

- Clarify the study objective and define the most appropriate types of data to collect;
- Determine the most appropriate field conditions under which to collect the data; and,
- Specify acceptable levels of decision errors that will be used as the basis for establishing the quantity and quality of data needed to support risk management decisions.

4.1.2 Site Data Quality Objectives

DQOs have been prepared to ensure that data proposed for collection would be of sufficient quality, appropriate for the intended uses, and useful in meeting RI/FS objectives. The overall QA objective of the project is to ensure that field and laboratory data collected during the RI is precise, accurate, representative, comparable, and complete. Specific procedures for obtaining these QA objectives will be presented in the Quality Assurance Project Plan described in Section 5.1 below. DQOs for the Ashland Lakefront Site include the following:

- Utilize laboratory procedures and the appropriate analytical support (i.e. data validation) for identifying contamination consistent with the levels for remedial action objectives identified in the National Contingency Plan.

- Identify the vertical and lateral extent of soil and groundwater contamination in the Ravine Fill (OU-1), the vertical and lateral extent of groundwater contamination in the Copper Falls Aquifer (OU-2), the lateral extent of soil and groundwater contamination at Kreher Park (OU-3), and the lateral and vertical extent of sediment contamination for the Chequamegon Bay Inlet (OU-4) utilizing historical and RI generated data;

- Further characterize the lateral and vertical extent of DNAPL in each operable unit;

- Utilize historical and RI generated site data to interpret geologic and hydrogeologic conditions with respect to evaluating contaminant migration pathways and the fate and transport of contaminants;

- Generate laboratory data with appropriate detection limits to compare to media specific cleanup standards and to assess attainment of risk-based criteria.

- Analyze historic and RI generated groundwater data with respect to Wisconsin groundwater quality standards (Preventive Action Limits (PAL) and Enforcement Standards (ES) per Wisconsin Administrative Code NR 140.);

- Analyze historic and RI generated soil data with respect to Wisconsin soil clean-up standards (residual soil contaminant levels (RCLs) and soil screening levels (SSLs) per Wisconsin Administrative Codes NR 720 and 746, respectively).

- To utilize historic and RI generated data necessary to perform human health and ecological risk assessments;

- To utilize historic and RI generated data necessary to develop site specific cleanup standards protective of human health and the environment; and,

- To utilize historic and RI generated data for the evaluation of potential remedial alternatives that will achieve site specific cleanup standards protective of human health and the environment.

4.2 BASELINE PROBLEM FORMULATION – OU 4

NSP believes EPA guidance for conducting an ecological risk assessment problem formulation should be synthesized with recent EPA strategy and guidance for management of contaminated sediment sites to develop a systematic and objective basis for addressing issues in UO-4 of the Site. This baseline problem formulation should:

- Developing a preliminary conceptual site model which incorporates a consideration of sediment stability;
- Developing the risk management goal and associated risk management objectives for OU-4;
- Making recommendations for assessment endpoints which are the critical ones that will influence site risk management decisions;
- Developing risk questions and risk hypotheses associated with these assessment endpoints;
- Proposing measurement endpoints that can be used to address risk hypotheses;
- Presenting a data needs analysis based upon these endpoints and risk hypotheses;
- Recommending approaches to acquire the necessary data to address the risk hypotheses;
- Deciding how the data quality objective (DQO) process should be used to develop the detailed study plans for measurement endpoints; and
- Identifying the management decisions for Site sediments that will determine the outcome of risk assessment.

The general details of the OU-4 study are presented below (Section 5.1.4). However, the details of these studies await the completion of the Problem Formulation Process which was initiated on March 27, 2003 at a meeting with USEPA, WDNR and NSP.

4.3 WORK PLAN APPROACH

This RI/FS Work Plan generally describes tasks that have been prepared consistent with discussions held among representatives of NSP, USEPA and WDNR and in anticipation of finalizing an acceptable Statement of Work ("SOW") appending a proposed AOC received by NSP on August 8, 2003. The specific investigation tasks described herein were developed through a joint effort in a series of technical meetings among USEPA, the WDNR, NSP and their representatives during Fall 2002 and Winter 2003. These investigations were further described in NSP's April 2003 markup of an initial proposed AOC and SOW. In addition, part of the tasks defined for OU-4 were developed from the "Strawman Baseline Problem Formulation for Affected Bay Sediments" prepared by URS in March, 2003. The purpose of this problem formulation document was to resolve and complete conclusions made by SEH in its 1998 and 2001 ERAs on the sediments. As described above, since the Problem Formulation process for OU 4 has not yet been completed there may be some modification or amendment to the RI investigations proposed here for OU 4.

The purpose of the RI/FS is to collect additional site characterization data that can be utilized to evaluate remedial alternatives to the extent necessary to assist USEPA in the selection of a proposed remedy for the Site. Site characterization will include the following tasks:

- Preparation of site specific plans including a Site Management Plan, a Pollution Control and Mitigation Plan, a Waste Management Plan, a Health and Safety Plan, and a Quality Assurance Project Plan, following approval of the final RI/FS Work Plan;
- Collection of soil samples from borings advanced in the vicinity of the former MGP to further characterize the lateral and vertical extent of contamination at OU-1 south of St. Claire Street;
- Installation of additional piezometers in the Copper Falls aquifer, and collection of subsequent groundwater samples, to further characterize the lateral and vertical (in

particular to determine if bedrock is affected) extent of groundwater contamination at OU-2;

- Conduct an air emission investigation to evaluate the potential inhalation pathway for exposure to potential hazardous vapors generated at the site;

- Conduct a borehole geophysical survey to verify subsurface geologic units, and perform a visual (down hole camera) inspection of two artesian wells at Kreher Park;

- Conduct exploration test pits at OU-3 to characterize the limits of the uncontrolled solid waste disposal area and former wood treatment/coal tar "dump" area.

- Collect soil samples from borings advanced at Kreher Park in the vicinity of the former seep area, the former solid waste disposal area, and former wood treatment area to further characterize the lateral and vertical extent of contamination at OU-3.

- Install additional monitor well at Kreher Park, and collect additional surface water (groundwater infiltration into the former WWTP) and groundwater samples to further characterize the lateral and vertical extent of groundwater contamination in OU-3;

- Complete field investigation and modeling for OU-4 that will, based upon the March 2003 site investigation data, include:
    i. confirmation of the vertical limits of contamination;
    ii. identification of areas to conduct ecological testing;
    iii. performance of PAH forensic analysis on sediment samples; and
    iv. establishment of representative background and "ambient conditions" values for site compounds of potential concern (COPCs).

- Complete a baseline problem formulation, finalize the data quality objectives and develop a supplemental sampling plan to complete data needs for OU 4. Data needs preliminarily identified to date include the following:
    i. pore water characterization;
    ii. comprehensive evaluation of the benthic community;
    iii. fish impact study;

iv. potentially, a wildlife ingestion study;
v. preliminary evaluation of the sediment stability;
vi. evaluation of wood waste impact;
vii. evaluation of dissolved phase COPCs in the water column with undisturbed sediments, and an evaluation of dissolved phase and free product COPCs in the water column with disturbed sediments;
viii. 28-day lifecycle tests for benthic species with and without ultraviolet light;
ix. caged mussel toxicity and bioaccumulation; and
x. fish early life-stage bioassay.

The detailed scope of work for the execution of these tasks and related efforts are discussed in Section 5.0.

5.1 DATA ACQUISITION

5.1.1 Preparation of Site Specific Plans

Following approval of the RI/FS Work Plan, site specific project plans will be completed as follows:

- A **Site Management Plan** (SMP) will be prepared to provide a written understanding of how access, security, contingency procedures, management responsibilities, and waste disposal are to be handled.

- A **Pollution Control and Mitigation Plan** (PCMP) will be prepared to outline the process, procedures, and safeguards that will be used to ensure hazardous and other waste material handling during the RI/FS. Implementation of this plan will prevent contaminants or pollutants to be released during implementation of the RI/FS activities.

- A **Waste Management Plan** (WMP) will be prepared to outline the management and disposal of investigation derived wastes (IDW) that are generated during the RI/FS process.

- A site-specific **Health and Safety Plan** (HASP) will be prepared to specify employee training, protective equipment, medical surveillance requirements, standard operating procedures, and a contingency plan in accordance with 40 CFR 300.150 of the NCP and 29 CFR 1910.120(1) and(1)(2) for all RI/FS activities, including site visits.

- A **Quality Assurance Project Plan** (QAPP) will be prepared in accordance with USEPA guidance (EPA QA/R-5) for all RI/FS activities. The QAPP will include a description of the project objectives and organization, functional activities, and quality assurance/quality control (QA/QC) protocols that shall be used to achieve the desired DQOs. These DQOs will specify the analytical methods for identifying contamination consistent with the levels for remedial action objectives identified in the National Contingency Plan.

- A **Field Sampling Plan** (FSP) will be prepared that defines the sampling and data collection methods that will be used for the project. It will include sampling objectives, sample locations and frequency, sampling equipment and procedures, sample handling and analysis, and a breakdown of the samples to be analyzed through the Contract Laboratory Program (CLP) or other sources.

- A **Data Management Plan** (DMP) will be prepared that outlines the procedures for storing, handling, accessing, and securing data collected during the RI.

5.1.2 Ravine Fill and Copper Falls Aquifer (OUs 1 & 2)

A field investigation will be completed at the Site to further characterize contamination in the ravine fill (OU-1) and Copper Falls aquifer (OU-2). The investigation will include the following tasks:

- The collection of additional soil samples from Geoprobe soil borings advanced in the backfilled ravine, and the collection of surface soil samples around the perimeter of the former MGP;
- The installation of additional piezometers in the Copper Falls aquifer;
- A borehole geophysical survey of a deep peizometer installed in the Copper Falls, and a visual camera inspection of the two artesian wells in Kreher Park; and
- An air emission investigation to evaluate the potential air inhalation pathway.

Diggers Hotline will be contacted for utility clearance prior to completing the Geoprobe soil borings, and installing piezometers in the Copper Falls aquifer. NSP will also obtain permission from adjacent property owners to access building interiors for the purpose of collecting indoor air samples. The site work will be scheduled with a contractor, and the agencies will be notified of the field schedule a minimum of 15 working days prior to site mobilization for the field investigation. A detailed description of each task follows.

Geoprobe Soil Borings and Surficial Soil Sample Collection

Additional soil samples will be collected from approximately 37 Geoprobe borings advanced in a regular grid pattern in the vicinity of the former MGP facility south of St. Claire Street. As shown on Figure 11, borings will be advanced inside the NSP building in the vicinity of boring B-31 located at the former MGP building, inside the portion of the NSP building between the courtyard and alley, in the courtyard area, and in the alley. These soil samples will be used to further characterize contamination in the vicinity of the former MGP.

Geoprobe borings will be advanced a minimum of five feet below the base of the filled ravine, or to a maximum depth of 20 feet. Soil samples will be collected continuously, and visually classified by a geologist or qualified geological engineer. Samples will be collected every two feet, and field screened with a photo-ionization detector (PID) equipped with a 10.6 eV lamp. Field screening results will be used to select soil samples for laboratory analysis. Samples submitted for laboratory analysis will be selected at the rate of one sample for every 10 feet of drilling. These soil samples will be analyzed for volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), and inorganic compounds included in Table 1 of this work plan.

Additional subsurface soil samples will also be collected from Geoprobe borings to evaluate background conditions. Background subsurface soil samples will be collected at intervals of 5, 10, and 15 feet from three borings advanced on the NSP property east, south, and west of the former MGP. These three borings will be advanced within 15 feet of the North side of Lakeshore Drive between Prentice and 3rd Avenues at locations 50, 100, and 150 feet west of Prentice Avenue. These locations were chosen to represent up gradient soil background conditions outside the limits of the filled ravine. Seven of these samples will be selected for laboratory analysis. Background subsurface soil samples will be analyzed for VOCs, SVOCs, and inorganic compounds included in Table 1 of this work plan.

Soil samples will be collected from unpaved areas around the former MGP facility to evaluate potential contamination within surficial soils for the direct contact risk to human health. Soil sample locations SS-1 through SS-12 are shown on Figure 11. Samples collected from the SS-1, SS-10, SS-11, and SS-12 borings will be used to represent background conditions.

At each sample location, soil will be collected from a depth between 3 and 12-inches utilizing hand tools. Samples will be placed in laboratory containers, held on ice, and shipped to the laboratory along with a completed chain-of-custody form. All samples will be analyzed for VOCs, SVOCs, and inorganic compounds included in Table 1 of this work plan.

Installation of Piezometers in the Copper Falls Aquifer

Additional piezometers will be installed at the Site at the locations shown on Figure 11. These wells will be installed as follows:

- MW-2C will be installed adjacent to existing wells MW-2R/MW-2AR in the underlying bedrock unit at an estimated depth of 200 feet;
- MW-7B will be installed adjacent to MW-7A in the former seep area at a depth of 55 feet below ground surface (20 feet deeper than MW-7A);
- MW-15A and MW-15B will be installed adjacent to existing well MW-15 located south of the NSP service center building. Piezometer MW-15A will be installed at a depth of 35 feet below ground surface, and piezometer MW-15B will be installed at a depth of 55 feet below ground surface;
- MW-21B will be installed adjacent to existing well MW-21A on the adjacent property east of the NSP facility at a depth of 55 feet below ground surface (20 feet deeper than MW-21A); and
- MW-23A and MW-23B will be installed in Kreher Park north of MW-21A and west of MW-7A. Piezometer MW-23A will be installed at a depth of 35 feet below ground surface, and piezometer MW-23B will be installed at a depth of 55 feet below ground surface.

Because MW-2C will be installed in an area where coal tar has been encountered, an outer well casing consisting of 6-inch diameter black iron casing will be installed to a depth of 60 feet. A 6-inch diameter boring will be advanced through the outer casing. Soil samples will be collected at 5-foot intervals below 60 feet, and visually classified by a URS geologist. A piezometer consisting of 2-inch diameter schedule 80 PVC well casing and screen will be installed in the uppermost bedrock. A well screen 5-feet in length with 0.010-inch slot size openings will be installed a minimum of 10 feet below the bedrock surface. The sand pack will be placed around the well screen, and the annular space seal will be backfilled with bentonite slurry tremied in place. The well will then be encased in flush mount protective well casing cemented in place.
The remaining peizometers will be installed in borings advanced with 4-1/4-inch ID hollow stem augers. Soil samples will be collected at 5-foot intervals from the ground surface with a split-barrel sampler, and visually classified by a URS geologist. Soil samples will be field screened with a photoionization device (PID) equipped with a 10.6 eV lamp. Field screening results will

be used to select screen depth intervals. If coal tar is observed in recovered soil samples, the shallow piezometer well screen will be placed at that interval. If coal tar is not encountered in recovered soil samples, then the shallow piezometer will be installed at the Miller Creek/Copper Falls interface. The deep piezometer will be installed in the Copper Falls formation 20 feet below the shallow piezometer. Both piezometers will be constructed with a 2-inch diameter schedule 40 PVC well casing and screen, and encased in flush mount protective well casing. Well screens five feet in length with 0.010-inch slot size openings will be used. The sand pack will be placed around the well screens as the augers are removed, and the annular space seal will be backfilled with bentonite slurry tremied in place. Access for well installation at the Kreher Park locations will be contingent on obtaining access from the City of Ashland.

A minimum of 12 hours after well installation, each well will be developed by removing ten well volumes of water. The elevation of the top of each PVC well casing will be surveyed relative to site datum. Drill cuttings will be temporarily stored on site until arrangements for disposal can be made. Purge water will be collected and discharged to the on-site treatment building.

Groundwater samples will be collected from existing wells and the new piezometers during the next quarterly sampling event in accordance with the existing groundwater monitoring program described in the January 2003 quarterly status report.

Borehole Geophysics and Well Casing Visual Inspection

Following the installation of well MW-2C, borehole geophysics will be performed to verify subsurface geologic conditions. Borehole geophysical tools will include a natural gamma survey and an induction log (electro magnetic conductivity) survey on well MW-2C. As described in Task 2 above, well MW-2C will be installed with an outer black iron pipe casing. Because this outer casing will interfere with the geophysical survey, well MW-2BR will be utilized to log geologic conditions to a depth of 70 feet, and MW-2C will be utilized to log conditions below 70 feet.

Additionally, borehole geophysics will be performed on wells MW-2A(NET) and artesian wells AT-1 and AT-2 in Kreher Park. Well casings for AT-1 and AT-2 will also be visually inspected and recorded on video tape with the aid of a down hole video camera. The borehole geophysical survey and visual inspection of the wells located in Kreher Park is contingent upon obtaining access from the City of Ashland.

Air Emissions Investigation

Air samples will also be collected to evaluate the inhalation pathway for exposure to potential hazardous vapors generated at the site. Air monitoring will be completed at the following locations:

- In the living space and basement of each home north of St. Claire Street;
- In the living space and basement of two homes located on the east side of Prentice Ave. between St. Claire Street and Lakeshore Drive directly across from the former MGP;
- In the school basement and a classroom at Our Lady of the Lake School; and
- In the NSP building in the vicinity of the former MGP.

Vapor monitoring air samples collected from residential homes (approximately seven home owners) will be contingent upon obtaining permission from each home owner, and the collection of samples from the school is contingent upon obtaining permission from the pastor of Our Lady of the Lake. The vapor air monitoring samples collected from the NSP building will be collected from the area corresponding to the highest concentrations of subsurface contamination. Additionally, three exterior, upwind samples will be collected to evaluate background conditions. (These numbers and locations were based on discussions with Mr. Henry Nehls-Lowe of the Wisconsin Department of Health and Family Services.) All samples will be analyzed for VOCs by Method TO14, and SVOCs by Method TO13. All vapor monitoring air samples will be collected in accordance with laboratory provided SOPs and USEPA draft guidance (December 2001) entitled *Evaluating The Vapor Intrusion To Indoor Air Pathway From Groundwater and Soils.*

In addition to the collection of air samples to evaluate indoor air quality, air samples will also be collected to evaluate the sanitary sewer as a potential migration pathway for vapors. Two air samples will be collected from manholes along St. Claire Street between Prentice and 3rd Avenues. All samples will be analyzed for VOCs by Method TO14, and SVOCs by Method TO13. The collection of these samples will be contingent upon obtaining permission from the City of Ashland.

5.1.3 Kreher Park (OU3)

A field investigation will be completed at the Site to further characterize contamination in Kreher Park (OU-3). The investigation will include the following tasks:

- Exploration test pits at Kreher Park to characterize the limits of the uncontrolled solid waste disposal area and former wood treatment/coal tar dump area;
- The collection of additional soil samples from Geoprobe soil borings advanced in the former seep area, the former solid waste disposal area, the former wood treatment area, and the former sewer mains leading to the former waste water treatment plan;
- An air emission investigation to evaluate the potential air inhalation pathway in the former waste water treatment plant;
- Installation of replacement well MW-7R in the former seep area, and collect groundwater samples from existing monitor wells at Kreher Park; and
- Collection of surface water samples where groundwater reportedly seeps into the basement of the former waste water treatment plant.

Diggers Hotline will be contacted for utility clearance prior to complete the exploration test pits, Geoprobe soil borings, and installing replacement well MW-7R at Kreher Park. NSP will need to obtain permission from the City of Ashland for this work, and for access to the former waste water treatment plant building interior for the purpose of collecting indoor air and surface water seep samples. The site work will be scheduled with a contractor, and the Agency will be notified of the field schedule a minimum of 15 working days prior to site mobilization for the field investigation. A detailed description of each task follows.

Exploration Test Pits

Exploration test pits will be excavated at Kreher Park to further characterize the limits of fill for the solid waste disposal area. Two test pits will be excavated on each side of the former solid waste disposal area (8 total). Each test pit will be excavated to a depth between 6 and 8 feet. Material encountered in each test pit will be visually described, and photographed as needed. Test pits will be terminated when the limits of fill have been determined, or until roads or buried utilities prevent additional excavation. Material removed from the test pits will be returned to the excavation. Grab samples of obvious solid waste material from the test pits will be collected, preserved and shipped for TCLP analysis for the appropriate parameters (health-based compounds) from Table 1, subject to the TCLP criteria.

Test pits will also be excavated in the vicinity of the former coal tar dump to determine the lateral extent of contamination. Two test pits will be excavated on the east and west sides, one on the north side, and one on the south side of the former coal tar dump area (6 total). Each test pit will be excavated to a depth between 6 and 8 feet. Material encountered in each test pit will be visually described, and photographed as needed. Test pits will be terminated when the limits of fill have been determined, or until roads or buried utilities prevent additional excavation. Material removed from the test pits will be returned to the excavation.

Geoprobe Soil Borings

Additional soil samples will be collected from the former seep area, the solid waste disposal area, the former coal tar dump area, and along utility corridors (former sewer mains) leading to the former WWTP. A total of 30 Geoprobe borings, 6 in each area (the sewer mains will likely require a minimum of 12 borings), will be advanced to the underlying clay layer (Miller Creek formation), or to a maximum depth of 15 feet; maximum depths for the borings along the sewer mains will be based on the apparent depth of trench backfill. Soil samples will be collected continuously, and visually classified by a URS geologist. Samples will be collected every two feet, and field screened with a photo-ionization detector (PID) equipped with a 10.6 eV lamp. Field screening results will be used to select soil samples for laboratory analysis. Samples submitted for laboratory analysis will be selected at the rate of one sample for every 10 feet of drilling. Samples will be placed in laboratory containers, held on ice, and shipped to the laboratory along with a completed chain-of-custody form. These soil samples will be analyzed for volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), and inorganic compounds included in Table 1 of this work plan.

Soil samples will be collected from unpaved areas in the vicinity of the former seep area, the solid waste disposal area, and the former coal tar dump area to evaluate potential contamination within surficial soils for the direct contact risk to human health. A total of 18 surface soil samples, 6 from each area, will be collected from a depth between 3 and 12-inches utilizing hand tools. Samples will be placed in laboratory containers, held on ice, and shipped to the laboratory along with a completed chain-of-custody form. All samples will be analyzed for VOCs, SVOCs, and inorganic compounds included in Table 1 of this work plan.

Air Emissions Investigation

Air samples will also be collected to evaluate the inhalation pathway for exposure to potential hazardous vapors generated at the site. Air monitoring will be completed in the basement of the former waste water treatment plant. All samples will be analyzed for VOCs by Method TO14, and SVOCs by Method TO13. All vapor monitoring air samples will be collected in accordance with laboratory provided SOPs and USEPA draft guidance entitled *Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils* (December 2001).

Well Replacement and Groundwater Sample Collection

Concurrent with the installation of piezometers in the Copper Falls Aquifer, URS will coordinate the installation of replacement well MW-7R in the vicinity of the former seep area. The well will be installed in a boring advanced with 4-1/4-inch ID hollow stem augers. Soil samples will be collected at 5-foot intervals from the ground surface with a split-barrel sampler, and visually classified by a URS geologist. Soil samples will be field screened with a photoionization device (PID) equipped with a 10.6 eV lamp.

The well will be constructed with a 2-inch diameter schedule 40 PVC well casing and screen, and encased in protective well casing. A well screen 10 feet in length with 0.010-inch slot size openings will be used. The sand pack will be placed around the well screen as the augers are removed, and the annular space seal will be backfilled with bentonite. Access for well installation will be contingent on obtaining access from the City of Ashland.

A minimum of 12 hours after well installation, the well will be developed by removing ten well volumes of water. The elevation of the top of the PVC well casing will be surveyed relative to site datum along with piezometers installed in the Copper Falls Aquifer. Drill cuttings will be temporarily stored on site until arrangements for disposal can be made. Purge water will be collected and discharged to the on-site treatment building.

Groundwater samples will be collected from existing wells MW-1 (NET), MW-2(NET), MW-3 (NET), MW-11, and TW-12 located in Kreher Park, proposed replacement well MW-7R, and well MW-5 installed by MSA (well MW-5 is located east of Prentice Avenue and south of the boat ramp) to evaluate groundwater quality at Kreher Park. Samples collected from well MW-7R will be used to evaluate post remediation groundwater quality in the vicinity of the former seep area. Samples collected from wells MW-1 (NET) and MW-2(NET) will be used to evaluate groundwater quality in the vicinity of the former coal tar dump. Samples collected from TW-11 will be used to evaluate groundwater quality down gradient from the former seep area. Samples collected from MW-3 (NET) and MW-5 will be used to evaluate groundwater quality to the east, and the sample collected from TW-12 will be used to evaluate groundwater quality to the west.

Groundwater samples will be collected in laboratory containers, held on ice, and shipped to the laboratory along with a completed chain-of-custody form. These soil samples will be analyzed for volatile organic compounds (VOCs), semi volatile organic compounds (SVOCs), and inorganic compounds included in Table 1 of this work plan.

Surface Water/Seep Sample Collection

Samples of groundwater infiltrating the former WWTP will be sampled using surface water sampling procedures (grab samples) from the interior of the former plant. A total of three samples plus one duplicate will be collected. Samples will be analyzed for the same parameters as described above.

5.1.4 Chequamegon Bay Inlet (OU4)

A number of field as well as modeling investigations will be conducted to:

- Further characterize nature and extent of sediment contamination in the Chequamegon Bay inlet (OU-4) adjacent to Kreher Park (OU-3);
- Supplement the basis for conducting a baseline human health and ecological risk assessment with site-specific validation studies; and,
- Characterize sediment stability in the area for later consideration in the Feasibility Study.

These investigations are described generally in the following sections. The results of the Baseline Problem Formulation and Data Quality Objective process will provide additional details of these studies. Detailed study design will be developed for inclusion in the Field Sampling Plan, Data Management Plan and the Quality Assurance Project Plan to be developed as part of the RI Work Plan process.

5.1.4.1 Vertical Extent of Sediment Contamination

The results of the March 2003 sediment sampling will be combined with historical sediment sampling results to develop a refined characterization of the vertical distribution of sediment contamination within OU-4. Two-dimensional vertical profiles at each station sampled and three-dimensional isopachs of contaminant distribution in sediment over the OU-4 area will be developed for selected COPCs.

5.1.4.2 Identification of Candidate Sites for Ecological Sampling

The results of the March 2003 sediment sampling will be combined with historical sediment sampling results to develop a refined characterization of the spatial distribution of sediment contamination within OU-4. Isopleths for selected COPCs will be developed by kriging and used as the basis for identifying concentration gradients. The results of this evaluation will provide the basis for selecting locations for benthic community sample locations and for collecting sediments to be used in any further sediment toxicity tests that will be conducted.

5.1.4.3 Forensic Analysis for PAH Compounds

Forensic analysis of PAH compounds in selected sediment samples will be conducted. The results will be used to determine whether discrete sources of these PAHs can be identified.

5.1.4.4 Representative Background and "Ambient Conditions" Levels of COPCs

The results of the March 2003 sediment sampling will be combined with historical sediment sampling results as well as data from other nearby areas, e.g. the Barksdale Site, to establish a range of background and "ambient conditions" levels of COPCs. Samples collected from areas known to be unaffected by point sources of contamination will be pooled and summary statistics calculated for each COPC to establish "Reference Area" concentrations of COPCs.

5.1.4.5 Additional Validation Studies

Based upon the outcome of the Baseline Problem Formulation and Data Quality Objectives Analysis, further validation testing may be warranted. Pore water characterization, benthic community characterization, further sediment toxicity testing using both *Chironomous tentans,* as well as early life stages of fish, a fish impact investigation and a caged mussel bioaccumulation study have been preliminarily identified as some of those studies that will be used as additional lines of evidence in the Baseline Ecological Risk Assessment. In addition, if it is determined through these investigations that there is a potential for food chain effects via bioaccumulation of Site COPCs, a wildlife ingestion study will be conducted.

The refined characterization of the spatial distribution of sediment contamination within OU-4 that will be developed following receipt of the March 2003 sediment data will be the basis for identification of representative stations along a concentration gradient of selected COPCs where samples for these additional studies will be collected.

Pore Water Characterization

Samples collected for benthic community characterization and sediment toxicity testing will be split and pore water from these samples analyzed for sediment contaminants as well as hydrogen sulfide, ammonia and dissolved organic material.

Benthic Community Characterization

Five replicate surface sediment samples will be collected from several stations along concentration gradients of the primary COPCs. The selection of these stations as well as reference stations for this investigation also needs to consider the physical characteristics of the sediment, i.e. substrate type and depth. Samples will be collected with ponar grab or a similar device and returned to the laboratory for sorting and identification.

Sediment Toxicity Testing

Sediment samples from the same locations used for the benthic community characterization as well as the pore water characterization will be collected. These will be shipped to a selected laboratory (to be determined) for bioassay testing. In addition sediment samples from locations where sediment toxicity testing was conducted in 2001 by SEH will also be collected.
The testing protocols that have been preliminarily selected are the 28-day *Chironomous tentens* test using both natural and UV light and an early life stage fish bioassay study using Site sediment.

Caged Mussel Bioaccumulation Study

Caged mussels will be placed *in situ* along sediment COPC concentration gradients in Chequamegon Bay to determine the potential for local invertebrates to bioaccumulate Site COPCs. Tissue residues in caged mussels as well as other physiological measurements, e.g. scope for growth, will be evaluated. These measurements will determine the degree to which sediment-associated COPCs area are available to resident epibenthic organisms as well as the potential Site COPCs have for causing physiological effects in these organisms.

Fish Impact Study

An evaluation of the impact to adult fish will be conducted. This evaluation will include both a characterization of adult fish tissue residues of Site COPCs as well as an evaluation of whether Site COPCs have resulted in any deformities, e.g. fin erosion, or other histopathological effects.

Wildlife Ingestion Study

After conduct of fish tissue residue and mussel bioaccumulation studies and completion of wildlife ingestion models based upon these results, if it is determined that fish-eating wildlife are potentially at risk, a wildlife ingestion study will be conducted. This investigation will determine whether local wildlife that potentially utilize the aquatic resources of Chequamegon Bay accumulate sufficient levels of Site COPCs to cause adverse effects.

5.1.4.6 Evaluation of Wood Waste Impact

As part of the study design for the benthic community characterization, multiple sampling stations need to be established that not only can measure benthic community characteristics along gradients of contaminants but in areas with different wood waste characteristics as well. Reference stations representing different substrates, including the presence of wood waste, also need to be identified.

5.1.4.7 Preliminary Evaluation of Sediment Stability

This proposed task will employ both quantitative (i.e. modeling) and empirical techniques to determine sediment stability as recommended in the EPA Contaminated Sediment Remediation Guidance for Hazardous Waste Sites (USEPA 2002). Both of these approaches will be implemented in a screening level phase, and if the results of the screening level analysis indicate further investigation is warranted, a detailed analysis will be performed. Although the two approaches may involve different methods, they will be used jointly to draw conclusions about sediment stability at the Site.

Screening-level Quantitative Approach

The screening level quantitative approach consists of estimating the potential for erosion of existing sediments using process-based quantitative models of erosion and deposition. The sediment Operable Unit is in relatively shallow water and sheltered by marina structures that limit both wave propagation and circulation. However, tidal flows, waves generated by winds from the northeast and storm-generated currents potentially could provide hydrodynamic forcing to erode the contaminated sediments in the Site area. Therefore a wave/current interaction model, based on the Glenn and Grant (1987) and recent Madison (1999) methods will be implemented. Recent modifications to these approaches have been developed to account for bedform (ripples, sand waves etc.) evolution and migration and their effect on hydrodynamic response and sediment transport. These models require wave period, height and direction and current speed and direction as well as sediment characteristics as input.

For sediment stability analysis of contaminated sediments, it is necessary to consider the full range of forcing events that may lead to erosion. A single event may produce a small amount of erosion and transport, but when many events are integrated over extended time periods, they also could potentially lead to significant changes. Thus a statistical representation of forcing conditions for the area will be developed and the erosion analysis will be conducted for a range of conditions. The results will be combined to estimate the long-term potential for erosion.

To develop model inputs, a literature search will be conducted. The necessary information on measurements of waves and currents at the Site and in adjacent areas will be identified if available. If these data are not readily available, meteorological data will be used to estimate wave and current conditions in the area.

Data on sediment characteristics required for the quantitative approach depend on whether the sediments exhibit cohesive behavior. For non-cohesive sediments, which are generally in the medium silt to sand size range, grain size curves, mineralogy and bulk density will suffice. These parameters, along with data from numerous laboratory studies of erosion, are sufficient to characterize the erosion characteristics of the non-cohesive sediment. However, if there is a significant amount of fine silt or clay size particles (> 10%) or there is sufficient organic material in the sediments, the sediments may be classified as cohesive.

A review of existing data available in previous risk assessments (SEH 1998; 2002) indicates that cohesive characteristics may occur. The erosion characteristics of cohesive sediments are very site-specific, and there is very little guidance available in the literature for developing the characteristics from bulk sediment properties. The best method to characterize the erosion potential of Site sediments is to use laboratory testing of Site sediment samples or in-situ erosion testing. Both of these methods will be pursued if warranted by the study. In addition, these studies may include an evaluation of dissolved phase COPCs in the water column over undisturbed sediments as well as evaluation of dissolved phase and free product COPCs in the water column over recently disturbed sediments.

The presence of wood chips may alter the erosion characteristics of the sediments and create conditions that are unlikely to have been studied previously. Therefore a diligent effort to obtain site-specific estimates will be made. It is noted that standard erosion testing may be difficult for contaminated sediments due to health and safety issues. If no laboratory can be found to handle the sediments then we will rely on data from the literature and best engineering/scientific judgment to develop the erosion parameters.

The results of this quantitative analysis will be combined and evaluated in conjunction with conclusions drawn from the empirical analysis described below, which also will be conducted simultaneously as part of the screening level phase. Quantitative approaches are known to be sensitive to model parameter values as well as dependent on site-specific data, which is often difficult to obtain. The empirical study will provide insight into the site-specific sediment transport processes and yield quantitative bounds that can be used to constrain and guide the quantitative analysis.

Empirical Approach

The empirical analysis will develop a conceptual model that best characterizes sediment stability at the Site. The conceptual model developed as part of this empirical analysis will attempt to describe the historical development of the existing contaminated sediments by considering various possible sediment and contaminant transport mechanisms and pathways. It may also be used to estimate historic site-specific transport rates and provide a basis for estimating future rates of sediment erosion and deposition.

The empirical analysis will rely mostly on analysis of existing data such as the sediment borings, vertical profiles of contamination, sediment deposition rates, physical sediment characteristics as well as other Site data on land use characteristics, regional hydrography, river sediment loading rates, and contaminant behavior in sediment, soils and water.

Contamination in the Ashland sediments appears to be mainly confined to a sediment layer extending a few hundred feet from the shoreline. The layer has a maximum thickness near the shoreline, typically 3 to 4 feet, and tapers off in the offshore direction. The layer is characterized by the presence of wood chips and most of the contamination is confined to this layer, although some contamination appears to exist just below the wood chip layer. The wood chips apparently were derived from local material, either from the sawmill or directly from logs floated and rafted into the Ashland area.

Based upon a review of existing data, there are at least two possible conceptual models that explain the current contaminant distribution at the Site. These models are preliminary, but serve as a starting point for the empirical analysis.

In the first conceptual model, it is noted that much of the existing shoreline and some of the marina structures were created by back-filling soil into the bay. It is possible that the process of back-filling, which is assumed to have occurred episodically between 120 and 60 years ago, created most of the contaminated wood-chip laden sediment layer. The backfill material, which was likely generated from the bluff and surrounding area, contained wood processing wastes as well as contamination from facilities operating in the area. NSP has produced documentation that it believes indicates the PAH contamination measured in the sediments has been generated from multiple sources (e.g., wood treatment at the former Schroeder Lumber facility and the former MGP). As this material was transported to the harbor, some of it escaped into the surface water and settled out in the near shore area. The shape of the wood-chip layer, thick near the shoreline and tapering offshore, is consistent with this view.

In this interpretation, most of the contamination was derived from existing soil and surface contamination associated with the back-fill material. It is also possible that sediments associated with surface runoff and groundwater transport contributed to the development of the deposit. Both contaminated and uncontaminated sediments reached the Site from rainfall induced surface runoff originating in the watershed adjacent to the Site. It is alternatively possible that contaminated surface runoff mixed with re-suspended sediments and contributed to the contaminated sediment layer as it evolved. However, it is likely that these processes only played a secondary role relative to the contamination derived from the back-filling.

If this interpretation is substantiated, it may imply that the sediments are fairly stable. The contaminated layer would not require historic or ongoing active sediment transport to have developed, and therefore it is possible the transport is low and insignificant in the area and sediments are relatively stable.

Additional data will help quantify and verify this conceptual model. One or more soil borings taken just inland of the shoreline will be analyzed for sediment COPC content. If a wood-chip-laden layer is also present in the borings, and at elevations consistent with the offshore borings, then it is evidence that the contaminated layer was created predominantly by back-filling activities. Additionally, higher resolution vertically-stratified, e.g., at 2cm intervals, profiles of selected Site COPCs in a few select sediment cores could provide additional information for evaluating historic and current transport processes and rates. Finally, if analysis of the inland soil borings do not provide sufficient information, it may be necessary to conduct age dating (most likely Pb_{210}) to help quantify transport rates.

An alternate conceptual model for the evolution of the contaminated sediment layer is based on regional sediment transport patterns. In this interpretation, much of the sediment that comprises the layer may have originated up and down shore of the Site. Sediment was (and possibly still is) transported via waves and currents all along the shoreline and during high energy events and the sediment that makes its way into the Site will deposit during the waning phase of the event. Although the sediment may have been contaminant-free at its origin, it likely mixed with contaminated runoff and/or contaminated sediments from the watershed adjacent to the Site, and then deposited at the Site.

It is known that logging was active during the last 120 years in the region. Logging could have provided a steady source of sediment to the harbor area since logging activities are known to increase soil erosion and provide additional source of sediments to rivers. A review of stream and river networks in the area show two drainage basins, one to the east and a larger one to the west. These rivers may have carried relatively large sediment loads to Chequamegon Bay, some of which eventually were deposited at the Site. It is likely that the current sediment load has been reduced relative to loads that occurred during the period of relatively uncontrolled historic logging activities, due either to reduced logging activities and/or improvement in logging procedures.

In this conceptual model, the evolution of the contaminated sediment layer occurred fairly continuously, due primarily to the sediment loads associated with the regional logging industry. In a large-scale long-term view, for the period of 120 to 60 years ago, the Bay was unable to flush the anthropogenic source of sediments at the rate that they were supplied. The hydrodynamic forces may have been able to remove some of the additional load to deeper water but not all of it. Thus the sediments began to accumulate along the shoreline as well as in deeper waters in the Bay. In terms of sediment balance, there was net sediment input into the Bay. If the logging industry based sediment load has actually been reduced, then the sediment balance near the coastline may begin shifting from depositional to erosional. However, the erosion rates may be relatively low, due to the relatively low hydrodynamic energy and limited fetch lengths in the area. In either case, quantification of this conceptual model will determine net erosion or depositional rates.

Additional data needed to quantify this conceptual model is similar to that needed for the previous one, except that the upland soil borings will not be needed. The age dating profiles from sediment borings could have one of two characters; it may indicate an age fairly uniform throughout the layer, which indicates that backfilling may be the dominant process, or it may indicate a more gradual development, consistent with the regional sediment transport interpretation. Similar conclusions can be drawn from the structure of high-resolution (i.e. 2 cm) contaminant vertically-stratified profiles in key sediment cores.

The preliminary analysis of empirical data described above is meant to be a starting point for the screening level phase. Clearly, additional data exists which has not been included in developing these models. The work plan for the empirical analysis consists of further development of these models, inclusion of other data sources and results from the proposed additional data collection, as well as considering alternate hypotheses individually or in combination. Other data that could be helpful are USGS river flow and sediment load data, either from adjacent watersheds or nearby watersheds, historic and current land use maps, detailed operational data for the Site and adjacent areas (including regional logging practices), meteorological data, and oceanographic data for Chequamegon Bay.

At the conclusion of the screening level phase, results from the quantitative and empirical approaches will be combined to make an initial assessment of sediment stability at the Site.

Other Potential Sediment Stability Investigations

If the screening level analysis does not produce conclusive estimates of the sediment stability, an additional phase will be conducted which will be based on hydrodynamic and circulation modeling. The model will be used to estimate sediment deposition and erosion in and around the Site. This analysis will involve additional data collection for model calibration and forcing. The model will be either a 2 or 3D numerical model, consistent with the US Army Corp of Engineers Surface Water Modeling System ADCIRC and M2D models. The data collection and modeling plan will be developed at the time the detailed modeling is determined necessary (i.e., at the end of the screening level phase). Data and information obtained in the screening level phase will be used to guide the development of the data collection and modeling phase

5.2 SAMPLE ANALYSIS

All soil, sediment, and groundwater samples collected during the RI will be analyzed by Northern Lakes Service, Inc. (NLS) of Crandon, Wisconsin. All air samples will be analyzed by Severn Trent Laboratories (STL) of Knoxville, Tennessee. Soil, sediment, and groundwater samples will be analyzed for constituents listed in Table 1. Air samples will be analyzed for constituents included in Table 2.

Benthic community samples and sediment bioassays will be analyzed by a laboratory to be determined.

All samples will be collected in accordance with the approved FSP and QAPP. As described in Section 5.1 above, both plans will be submitted for Agency review after the RI/FS Work Plan has been approved.

5.3 ANALYTICAL SUPPORT AND DATA VALIDATION

Field personnel will be responsible for the custody of the samples from the time they are collected until they are transferred to the sample carrier for shipment. Personnel handling the samples will be kept to a minimum to minimize transfers. Each sample collected will be identified with a unique sample number. Sample identification information will be printed on a self-sticking sample container label affixed to the container. The sample label will contain the sample ID number, date collected, time of collection, site name, sample location (i.e., well number), sample date, analytes of interest, preservatives, and other pertinent information. Labels will be completed using indelible ink. After labels are filled out completely, labels will be covered with clear tape. The sample number, location, media type, observations, preservatives, and other sampling information will be recorded in the field book or on the appropriate sampling form.

Samples will be placed in a thermal chest on ice immediately after sample collection. The chest will remain in the sampler's view or will be locked in a secure location at all times prior to transport to a laboratory. Prior to laboratory transfer, samplers will prepare and package samples in accordance with the following procedures:

- Fill out chain of custody form completely and accurately;
- Check each of the sample bottle caps to ensure that each cap is secure;
- Rinse the outside of the sample bottles using de-ionized water to remove residual dirt, if necessary;
- Place each sample container in a sealable zip-lock bag of appropriate size and secure with strapping tape;
- Place sample bottles in the cooler in an upright position;
- Ensure that glass sample containers do not touch;
- Place inert packaging materials under, around, and above sample bottles to ensure that the containers are not broken during shipment;
- Completely cover sample bottles with ice to ensure samples are preserved at the proper temperature (4°C) upon arrival at the laboratory;
- Put paper work (chain of custody) in a sealable plastic bag and tape it inside the lid of the cooler;
- Obtain copies of the chain of custody for project file prior to securing lid;
- Secure lid by taping with strapping tape.
- Wrap cooler completely with strapping tape in at least two places (do not cover labels); and
- Attach completed shipping label to top of cooler, and place "This side up" and "Fragile" labels on cooler.

Samples will be packaged properly for shipment and dispatched to the laboratory. A separate chain-of-custody record will accompany each cooler. Shipping containers will be sealed for shipment to the laboratory. The method of shipment, courier name(s) and other pertinent information will be entered in the "remarks" box. The last copy of the form will be removed and retained. The original and remaining copies will be placed inside a plastic zip-lock bag taped to or placed at the top of the container. After the container is closed, the container will be sealed by wrapping it with a minimum of two complete wraps of strapping tape. The samples will be shipped by overnight carrier or picked up by the laboratory daily, or as often as necessary to ensure that samples meet holding times. The sample shipping receipt will be retained as part of the permanent chain of custody documentation.

The NLS Project Manager for this project will be Mr. Steve Mlejnek. Contact information for Mr. Mlejnek is as follows:

Mr. Steve Mlejnek
Northern Lakes Service, Inc
400 North Lake Avenue
Crandon, Wisconsin 54520
(715) 478-2777
(715) 478-3060 fax

The STL Project Manager for this project will be Mr. Rich LaFond.

Mr. Rich LaFond
Severn Trent Laboratories, Inc.
5815 Middlebrook Pike
Knoxville, Tennessee 37921
(865) 291-3000
(865) 584-4315 fax

Both laboratory project managers will be responsible for coordinating with laboratory personnel for sample management to ensure the proper management of samples. Laboratory personnel include inorganic and organic operations supervisors, laboratory quality assurance officer/managers, laboratory analysts, and laboratory sample custodians. A brief summary of laboratory staff responsibilities follows:

Laboratory Project Manager

- Coordinates the completion and delivery of the final analytical report;
- Ensures that client objectives are met; and
- Oversees the overall completeness of the final analytical report.

Laboratory Inorganic and Organic Operations Supervisors

- Directs the laboratory's analytical programs;
- Coordinates projects and associated workloads;
- Executes laboratory administrative functions; and

- Ensures compliance with appropriate analytical methods.

Laboratory Quality Assurance Officer/Manager

- Overview laboratory quality assurance;
- Overview QA/QC documentation;
- Overseeing of detailed data review;
- Decides laboratory corrective actions, if required;
- Technical representation of laboratory QA procedures;
- Preparation of laboratory Standard Operation Procedures; and
- Approval of Quality Assurance Manuals.

Laboratory Analysts

- Responsible for equipment maintenance and calibration;
- Assume direct responsibility for data generation;
- Self-review of generated data;
- Documentation of sample analysis anomalies; and
- Inclusion of appropriate quality control samples into analysis scheme.

Laboratory Sample Custodians

- Receive and inspect the incoming sample containers;
- Record the condition of the incoming sample containers;
- Sign appropriate documents;

- Verify chain of custody and its correctness;
- Notify laboratory project manager and laboratory analysts of sample receipt and inspection;
- Assign a unique identification number and customer number, and enter each into the data management system; and
- Arrange proper secure sample storage.

In accordance with each laboratories' Quality Assurance Plan, independent quality assurance will be provided by each laboratory Project Manager, the Inorganic Operations Supervisor, the Organic Operations Supervisor, the Quality Assurance Officer/Manager, Laboratory Analysts, and Laboratory Sample Custodians as required prior to release of all data to NSP. Upon receipt of data from each laboratory, all laboratory data collected during the RI will validated to ensure that the data are accurate and defensible. The data results will be reviewed against validation criteria. A

Data Validation Report will be developed for submittal to USEPA after all data has been validated.

5.4 DATA EVALUATION AND TECHNICAL SUPPORT

Data gathered during the RI/FS will be gathered and presented in Data Evaluation Summary Report. Initially, a data usability evaluation will be completed for all laboratory and field generated data to evaluate the usability of the data. If the data is deemed usable, data will be then be tabulated, evaluated, and interpreted. Data to be evaluated includes geologic data (soil and sediment), air data, groundwater data, surface water data, waste data, geophysical data, and ecological data. A database will be designed and set up for pertinent data, and final data tables will be prepared. Utilization of this data for modeling may also be performed as needed.

5.5 RISK ASSESSMENT

Baseline Human Health Risk and Ecological Risk Assessments will be performed to evaluate the potential that Site contaminants present a current or potential risk to human health and the environment in the absence of any remedial action. If results indicate that there are unacceptable risks to human health or the environment under current conditions, they will be utilized as one line of evidence to establish preliminary remediation goals for the various Operable Units.

The draft Human Health Risk Assessment Report will be submitted to USEPA for review. Agency comments will be incorporated into the final Human Health Risk Assessment Report. The Human Health Risk Assessment will include the following:

- **Problem Formulation:** The development of a site conceptual model which considers Site contaminants, exposure pathways and contaminant behavior and human receptors;

- **Hazard Analysis:** The completion of a hazard identification evaluation to identify hazardous substances present at the Site based on a review of all historic and RI/FS generated data;

- **Exposure Analysis:** An exposure assessment to identify the magnitude of actual or potential human exposures, and potential exposure routes for receptors. This will include an evaluation of the likelihood of receptor exposure, and the development of acceptable exposure levels. Reasonable maximum estimates and central tendency estimates of exposure will be developed for both current and potential land use conditions;

- **Risk Characterization:** A risk characterization to determine if concentrations of contaminants at or near the Site are affecting or could potentially affect human health. Chemical-specific toxicity information, combined with quantitative and qualitative information from the exposure assessment will be compared to measured levels of contaminant exposure levels and the levels predicted through environmental fate and transport modeling for this evaluation; and,

- **Uncertainty Analysis:** The identification of critical assumptions (e.g., background concentrations and conditions), limitations, and uncertainties of the risk assessment; and.

An Ecological Risk Assessment will be completed to evaluate and assess the risk to the environment posed by Site contaminants utilizing historical data and data resulting from other studies identified during the Baseline Problem Formation process. A draft Ecological Risk Assessment Report will be submitted to USEPA for review. Agency comments will be incorporated into the final Human Health Risk Assessment Report. The report will include the following:

- **Problem Formulation:** Problem formulation includes stressor characterization and identification of chemicals of potential concern (COPCs), identification of ecological receptors of concern (ROCs), assessment endpoints and measure of effects (formerly termed measurement endpoints) selection, and site conceptual model (SCM) development.

- **Analysis:** The analysis phase is based on the SCM and includes exposure and effects analysis. Data on the effects of the stressors (measures of effect) are summarized and related to the assessment endpoints (general, large-scale expressions of ecological components or characteristics that may be at risk).

- **Risk Characterization:** In the risk characterization step, which includes risk estimation and risk description, exposure and effects information developed in the analysis phase are integrated, together with any subsequent field or laboratory work, to evaluate the likelihood of adverse ecological effects associated with site-related stressors. It includes a summary of assumptions used as well as the uncertainties and strengths and weaknesses of the analyses since the ecological risk assessment process relies on assumptions that have various associated degrees of accuracy and validity. Uncertainty surrounding risk estimates consists of (1) real variation (reflecting actual ranges in biological responses), (2) lack of adequate definition of basic physical, chemical, and biological properties and processes, (3) simplifying assumptions used to approximate key variables, and (4) actual error. Qualitative and/or quantitative evaluation of these factors is a critical component of ecological risk assessment. The ecological significance of the potential risks is discussed in the context of the types and magnitude of the effects, their spatial and temporal patterns, and the likelihood of recovery.

5.6 REMEDIAL INVESTIGATION REPORT

Pertinent historic data and data collected during RI/FS activities will be presented in a Remedial Investigation Report. A draft Remedial Investigation Report will be submitted to USEPA for review. Agency comments will be incorporated into the final Remedial Investigation Report. The report will include the following:

- A description of the Site and detailed site history;
- Site characteristics including a description of the regional and site geology and hydrogeology, meteorology, demographics and current land use, and an ecological assessment;
- A description of the field methodologies used for well installation, borehole logging, geophysical logging, and hydrogeologic assessment. Additionally, sample collection procedures for air, soil, groundwater, surface water, sediment, and biological sample collection will be described;
- A description of completed RI/FS activities, laboratory results and a description of analytical methods used;
- A description of the nature and extent of contamination including the identification of contaminant source areas and contaminant distribution patterns and trends;
- A description of the fate and transport of contaminants to include characteristics of contaminants, transport processes, and contaminant migration trends;

- An preliminary evaluation of potential remedial alternatives; and
- Summary and conclusions.

The objective of the report will be the accurate presentation of Site conditions with respect to contaminated media, extent of contamination, and fate and transport of contaminants. Key contaminants will be selected based upon persistence and mobility in the environment and the degree of hazard. These key contaminants will be evaluated for receptor exposure to estimate contaminant levels that may be reach human or environmental receptors. Water quality standards, indoor air standards, soil cleanup standards, and any other appropriate criteria accepted by the EPA will be used to evaluate potential effects on human receptors exposed to contaminants above the appropriate standards and guidelines.

5.7 REMEDIAL ALTERNATIVES SCREENING

At the completion of the RI report, screening of remedial alternatives will be performed. This screening will evaluate those methods that will reduce toxicity, mobility and volume of waste to provide adequate protection of human health and the environment. This will include the no-action alternative, as well as those methods that provide restricted exposure (institutional controls) under the category of "limited action" alternatives.

A draft technical memorandum will be prepared describing the process of this screening. Initially, remedial action objectives (RAOs) will be established using existing information as well as data that will be developed and presented in the RI report. The RAOs will also be established based upon the conclusions presented in the Risk Assessments. General response actions for each of the media of concern will be established, alternatives will be screened in accordance with the National Contingency Plan (NCP), and a list of viable alternatives established and presented in the draft memorandum. Following review by USEPA, a final Technical Memorandum will be prepared.

5.8 TREATABILITY STUDY

The results of the remedial alternatives screening will determine if a treatability study for promising technologies will be needed. In that event, a treatability study work plan will be prepared and submitted for agency approval. The work plan will describe the technology to be tested, equipment, procedures, and management of wastes used in the study. The plan will describe the bench testing, and if necessary, any on-site pilot testing. Following approval of the work plan, the treatability study will follow the sequence of typical studies: bench testing, pilot testing, and field testing. A treatability study report will be prepared and submitted at the completion of the work. The report will document the effort to implement the studies, evaluating full-scale application of the technology based upon the actual results of the tests.

5.9 FEASIBILITY REPORT

Historic data and data collected during RI/FS activities will used to develop a Feasibility Study Report in substantial conformance with 40 CFR Part 300.430(e). A draft report will be submitted to USEPA for review. Agency comments will be incorporated into the final Feasibility Study Report. The report will include the following:

- A summary of Feasibility Study Objectives;
- A summary of Remedial Action Objectives;
- Incorporated information from the Remedial Investigation, Human Health Risk Assessment, and Ecological Risk Assessment reports;
- The identification and screening of potential remedial technologies;
- A description of potential remedial alternatives;
- A detailed analysis of each potential remedial alternative that will include a technical description of each remedial alternative that outlines the remedial strategies involved and identification of key ARARs associated with each alternative, and the remaining criteria in 40 CFR Part 300.430(e);
- A discussion that profiles the performance of each potential alternative with respect to each of the evaluating criteria, and a table summarizing these results;
- An evaluation that compares each selected potential remedial alternative; and
- Summary and conclusions.

5.10 POST RI/FS SUPPORT

NSP will provide technical support that may be required for preparation of the record of decision (ROD) for the site. Technical support will include attendance at public meetings, briefings and technical meetings with the USEPA, review of presentation materials, technical assistance on review of the Responsiveness Summary and Proposed Plan and ROD, and any review of a Feasibility Study Addendum.

6.1 SCHEDULE

RI/FS activities will begin with the submittal of this draft RI/FS Work Plan to the USEPA on August 22, 2003. This is after the receipt of the receipt of the General Notice on August 8, 2003 but prior to the effective date of the AOC to be negotiated between the parties.

In accordance with discussions among NSP, USEPA and WDNR, special emphasis will be placed by the USEPA to pre-approve that portion of the work plan dealing with the well installation and sampling, and Geoprobe soil sampling for OUs 1 & 2. The purpose of this pre-approval is the need to accelerate this work for it to be completed during the Fall, 2003. Accordingly, a mini-QAPP will be submitted to USEPA for review and approval for these specific OU 1 & 2 tasks on August 22, 2003 along with this draft RI/FS work plan. USEPA has agreed to accelerate the review of this QAPP to accommodate the Fall 2003 sampling schedule objective.

Subject to schedule adjustments negotiated in the context of the AOC/SOW discussions, following review of the remainder of the draft RI/FS Work Plan, a Final RI/FS Work Plan will be submitted to the USEPA within 15 days following receipt of USEPA's comments to this draft. The Site Management Plan, Pollution Control and Mitigation Plan, Waste Management Plan, and Health and Safety Plan will be submitted to the USEPA within 15 days of final Work Plan approval. The Quality Assurance Project Plan (for the remainder of the RI tasks), Field Sampling Plan, and Data Management Plan will be submitted to the USEPA within 30 days of final Work Plan approval. Within 30 days of approval of these Plans and assuming agreement on the terms and conditions of the AOC, the remainder of the RI activities will commence. It is estimated that RI activities for OU-1, OU-2, and OU-3 will be completed within 90 days, and activities for OU-4 will be completed within 180 days.

The Data Evaluation Summary Report will be submitted 45 days after receipt of all analytical results from the laboratory. This will be followed by the Data Validation Report, completed with 60 days of receiving all RI data. The draft Human Health and Ecological Risk Assessments will also be submitted 60 days after receipt of all lab data. The final HHRA and ERA will be submitted 30 days after receipt of USEPA's review comments on the drafts. A draft RI report will then be submitted within 120 days of the receipt of lab analyses. A Final RI report will be prepared within 30 days following the Agency review of the draft RI. The draft Remedial

Alternatives Technical Memorandum will be submitted 60 days after the Final RI report. The final Remedial Alternatives Technical Memorandum will be submitted 30 days after receipt of USEPA's review comments on the draft. This will trigger if a Treatability Study is warranted. In that event, a Treatability Study work plan will be submitted 45 days after submittal of the final Remedial Alternatives Technical Memo. If no Treatability Study is performed, the Draft Feasibility Study Report will be submitted 90 days following submittal of the final Tech Memo. In the event of a Treatability Study, the schedule for the FS will necessarily be developed at that time. Modifications to the schedule will be made as needed. A detailed proposed schedule for all RI/FS tasks is included in Appendix B.

7.1 PROJECT MANAGMENT

In accordance with the draft AOC, a Project Coordinator, Contractor, and Remedial Project Manager will be assigned to the Site. A description of each assignment follows.

Project Coordinator

Mr. Jerry Winslow of NSP will serve as project coordinator. Mr. Winslow has been involved with the project since August of 2000. He will be responsible for administration of all actions required of NSP by the USEPA and the WDNR. Contact information for Mr. Winslow is as follows:

Jerry C. Winslow
Xcel Energy
414 Nicollet Mall (RS-8)
Minneapolis , Minnesota 55401
(612) 330-2928
(612) 330-6357 Fax
jerry.c.winslow@xcelenergy.com

With copies to:

David A, Crass, Esq.
Michael Best & Friedrich LLP
P.O. Box 1806
Madison, Wisconsin 53701-1806
(608) 283-2267
(608) 283-2275 Fax
dacrass@mbf-law.com

Contractor

URS Corporation (URS) has been designated as the contractor for the project. URS (formerly known as Dames & Moore) has been involved with the NSP property since January 1995. URS will be responsible for completing the technical requirements required of NSP by the USEPA and the WDNR. Mr. Bert Cole of URS will serve as URS project coordinator. Mr. Dave Trainor of NewFields will serve as Project Manager as a subcontractor to URS. Dr. Weldon Bosworth of URS will serve as Senior Project Scientist, and will be responsible for directing the ecological risk assessment as well as studies relating to sediment stability and contaminant fate and transport in OU 4. Contractor contact information is as follows:

Bert Cole
URS Corporation
54 Park Place, Suite 950
Appleton, Wisconsin 54914
(920) 968-6900
(920) 968-6940 Fax
bert_cole@urscorp.com

Dave Trainor
NewFields
2110 Luann Lane, Suite 101
Madison, Wisconsin
(608) 442-5223
(608) 442-9013 Fax
dtrainor@newfields.com

Weldon Bosworth
URS Corporation
45 Hillside Drive
Gilford, NH 03249
603-524-1822
603-528-9674 Fax
wbosworth@metrocast.net

Curriculum vitae for Mr. Trainor, Mr. Cole, and Dr. Bosworth are included as Appendix C.

Remedial Project Manager

Mr. Jon Peterson of the Region 5 Remedial Response Branch of the USEPA will serve as Remedial Project Manager (RPM). All documents required of NSP by the USEPA will be submitted to the RPM, and a copy will be submitted to the WDNR. Contact information for USEPA is as follows:

Jon Peterson
Remedial Project Manager
United States Environmental Protection Agency – Region 5
77 West Jackson Blvd.. Mail Code SR-6J
Chicago, Illinois 60604-3590
(312) 353-1264
(312) 886-4071 Fax
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AND

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With copies to:

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melodia.craig@epa.gov

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Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. EPA/540/G-89/004. October 1998. USEPA (U.S. Environmental Protection Agency).

Ecological Risk Assessment for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final. 1997. Environmental Response Team, Edison, NJ. USEPA (U.S. Environmental Protection Agency).

Guidance for Ecological Risk Assessment. 1998. USEPA (U.S. Environmental Protection Agency).

Guidance for the Data Quality Objective Process. EPA QA/G-4. August 2000. USEPA (U.S. Environmental Protection Agency).

Evaluating The Vapor Intrusion To Indoor Air Pathway From Groundwater and Soils. December 2001. USEPA (U.S. Environmental Protection Agency).

NOTE: A listing of all documents presenting results from previously completed site activities is included in Section 1.5 of this report.

Tables

Table 1
Analyte List for Soil, Sediment, and Groundwater Samples
Ashland NSP Lakefront Superfund Site - Ashland, Wisconsin

Analyte VOCs	Analyte SVOCs	Analyte Inorganics
Benzene	Acenaphthene	Arsenic
sec-Butylbenzene	Acenaphthylene	Aluminum
Ethylbenzene	Anthracene	Antimony
Styrene	Benzo(a)Anthracene	Barium
Toluene	Benzo(a)Pyrene	Beryllium
1,2,4-Trimethylbenzene	Benzo (e) Pyrene	Cadmium
1,3,5-Trimethylbenzene	Benzo(b)Fluoranthene	Calcium
Total Xylenes	Benzo (k) Fluoranthene	Chromium (+3)
	Benzo(g,h,i)Perylene	Chromium (+6)
	Chrysene	Cobalt
	Dibenzo(a,h)Anthracene	Copper
	Fluoranthene	Cyanide
	Fluorene	Iron
	Indeno(1,2, 3-cd)Pyrene	Lead
	1-Methyl Naphthalene	Magnesium
	2-Methyl Naphthalene	Manganese
	Naphthalene	Mercury
	Phenanthrene	Nickel
	Pyrene	Potassium
	Dibenzofuran	Selenium
	Phenol	Silver
	2-Methyl Phenol	Sodium
	3-Methyl Phenol	Thallium
	4-Methyl Phenol	Vanadium
		Zinc

Table 2
Analyte List for TO13 and TO14 Air Samples
Ashland NSP Lakefront Superfund Site - Ashland, Wisconsin

VOCs	SVOCs
TO-14	**TO-13**
Dichlorodifluoromethane	Acenaphthene
1,2-Dichlorotetrafluoroethane	Acenaphthylene
Chloromethane	Anthracene
Vinyl Chloride	Benzo(a)Anthracene
Bromomethane	Benzo (k) Fluoranthene
Chloroethane	Benzo(g,h,i)Perylene
Trichlorofluoromethane	Benzo(a)Pyrene
1,1 – Dichloroethene	Benzo(b)Fluoranthene
1,1,2 – Trichlorotrifluoroethane	Benzo (e) Pyrene
Methylene Chloride	Chrysene
1,1 – Dichloroethane	Dibenzo(a,h)Anthracene
cis – 1,2-Dichloroethene	Fluoranthene
Chloroform	Fluorene
1,1,1 – Trichloroethane	Indeno(1,2, 3-cd)Pyrene
Carbon Tetrachloride	Naphthalene
Benzene	Phenanthrene
1,2 – Dichloroethane	Pyrene
Trichloroethene	
1,2 – Dichloropropane	
cis – 1,3 – Dichloropropene	
Toluene	
Trans - 1,3 – Dichloroproene	
1,1,2 – Trichloroethane	
Tetrachloroethene	
1,2 – Dibromoethane	
Chlorobenzene	
Ethylbenzene	
m/p – Xylene	
o – Xylene	
Styrene	
1,1,2,2 – Tetrachloroethane	
1,3,5 – Trimethylbenzene	
1,2,4 – Trimethylbenzene	
1,3 – Dichlorobenzene	
1,4 – Dichlorobenzene	
Benzyl Chloride	
1,2 – Dichlorobenzene	
1,2,4 – Trichlorobenzene	
Hexachlorobutadiene	

Appendix C

Curriculum Vitae for Project Personnel

AREAS OF EXPERTISE

- Hazardous Waste Management
- Air Pollution Control

EDUCATION

Master of Science, Environmental Engineering, University of Florida, 1976.

B. A., Biology, West Virginia University, 1974

PROFESSIONAL HISTORY

Senior Environmental Engineer, URS Corporation 1990-Present.

Senior Environmental Engineer, Booz-Allen, Atlanta, GA 1988-1990.

USEPA Region IV, Section Chief, Unit Chief, Compliance Auditor 1977-1988.

AFFILIATIONS

Federation of Environmental Technologists

Society of American Military Engineers

Wisconsin Paper Council

Wisconsin Manufacturers Association

REPRESENTATIVE EXPERIENCE

Mr. Cole managed the Atlanta Office of Dames & Moore from 1994 until 1997. He was responsible for all aspects of management of the commercial sectors consulting office including personnel, marketing, accounting, and contracting and collections. Revenues exceeded $6 million per year with a staff of 60 people. Before that he managed several program offices in EPA Region IV from 1981-1988, which included both air and waste programs. Staff size ranged from 7-95 people. Included personnel management, budgeting, policy implementation, and acting as Chief negotiator of consent agreements with industry. Since joining URS in February 1990, Mr. Cole has managed the following projects:

- Project Director for evaluation of the groundwater monitoring system at a nuclear reactor core storage facility. Study included ground water monitoring, groundwater modeling and evaluation of reporting systems to determine whether or not a leak in the containment facility would be promptly identified. Report was submitted to the NRC as part of a licensing application.

- Project Director for the soil and groundwater remedial designs and remedial action for a superfund site contaminated with various pesticides and pesticide degradation products. Project involves coordination of several major individual sites with different PRPs at each site. Responsibilities include technical oversight, negotiation strategy development, and preparation of remedial design documents. Project Director for the preparation of the RAWP and the demolition of the remaining structures on site. Project Director for the oversight/implementation of the selected remedies which included thermal desorption, phytoremediation of groundwater, natural attenuation and off sight disposal of heavy metals contaminated materials.

- Project Director for a Corrective Measures Study under the Georgia HSRA program for a MGP site in Georgia. Study involved evaluation and costing of remedies including quantification soils requiring remediation.

- Project Director for a state lead removal action involving chlorinated solvent contaminated soils and groundwater. Remedy included removal of contaminated soils and treatment of contaminated water that was impacting a municipal well field.

- Project Director for preparation of a Corrective Action Permit for a major chemical distribution facility in the Mid-West. Plan included remediation of groundwater, soil, UST's, buildings and sumps.

- Project Director for a site investigation of a crude oil pipeline terminal including assessment and remediation of on-site soils.

- Project Director for the removal and destruction of waste oils, contaminated soils, and aboveground storage tanks under an EPA superfund unilateral 106 order. Wastes included RCRA/TSCA materials. Total removal costs exceeded $6.0 million dollars. Project included review and selection of remediation techniques for contaminated water, soils, and sludge.

- Project Director for the preparation of RCRA Corrective Action Plans, RCRA Closure Plans, and RCRA Facility Assessments at several manufacturing facilities in the Midwest. Projects included corrective measures studies.

- Project Director for the development of spill prevention, control, and counter-measures (SPCC) plans and contingency plans for several military facilities.

- Project Director providing regulatory and design support on the removal or upgrades of petroleum UST tanks at various military and industrial facilities in Illinois, Wisconsin, and Michigan.

- Project Director for engineering and field oversight on the removal and disposal of contaminated soils from a partially submerged vessel. Project included review of in-situ aeration and Bioremediation technologies for treatment of contaminated soils and sediments.

- Project Director for Phase 1, Phase 2, and geotechnical evaluations for the expansion of a major restaurant chain.

- Provided technical consulting services to a PRP involved in remediation of a creosote contaminated superfund site in the Midwest. Technologies considered include Bioremediation, incineration, soil washing, and containment.

- Project Director for evaluation of an Electric Arc Furnace baghouse to upgrade its performance for a steel casting operation. Evaluated the control equipment, hoods, and ductwork and made recommendations which resulted in significant capture efficiency increases.

- Project Director for air emission point inventories and prepared air permit forms for various military and industrial clients. Services included survey of facility, identification and quantification of emissions and preparation of air permits. Clients included automobile assembly plants, plastic extrusion facilities, chemical storage facilities, and military bases.

- Conducted compliance audits for a major plastic extrusion facility to identify potential air, water, and hazardous waste activities that were in noncompliance.

- Project Director for the design of a leachate collection impoundment for a sanitary landfill

- Project Director for the evaluation of a groundwater interceptor trench system and associated groundwater treatment system at a chemical distribution facility.

- Project Director for a process safety management study for a manufacturing client.

- Project Director on a Phase I and Phase 2 site evaluation of a crude oil pipeline terminal.

- Project Director for design of a bank stabilization system for a section of bank along the Chicago River.

DAVID P. TRAINOR, P.E., P.G.
Associate

EXPERIENCE SUMMARY

Mr. Trainor has over 23 years experience in numerous environmental projects and investigations, which include feasibility/plan of operation landfill siting studies, RI/FS programs, groundwater assessments, remedial design, and construction management. He has represented industrial and government clients in technical negotiations and presentations involving state and Federal regulatory agencies.

NewFields currently has 13 offices in Georgia, Alabama, Tennessee, Texas, New Jersey, Colorado, Maryland, Massachusetts, and Wisconsin and an International Division with projects in over 70 countries. The firm was established to focus on resolution of high profile environmental liabilities. Prior to joining NewFields, Mr. Trainor was employed by URS Corporation (formerly Dames & Moore) for 16 years where he held several positions, most recently as managing principal of the Madison, Wisconsin office.

REGISTRATIONS AND PROFESSIONAL AFFILIATIONS

Professional Engineer, Wisconsin, Michigan, Pennsylvania, California, Idaho, Iowa
Professional Geologist, Wisconsin
American Society of Civil Engineers
International Society for Soil Mechanics and Foundation Engineering
American Institute of Professional Geologists, Certified Professional Geologist, AIPG

EDUCATION AND TRAINING

B.S., Geology, Ohio State University, 1975,
B.S., Civil Engineering, Ohio State University, 1978
M.S. Civil and Environmental Engineering, University of Wisconsin, Madison, 1983
OSHA 40-hour Hazardous

PROFESSIONAL HISTORY

NewFields, Associate, 2003 to present
URS Corporation (previously Dames & Moore), Principal-in-Charge/Senior Engineer, 1987 to 2003
RMT, Inc., Geotechnical Project Engineer, 1983 to 1984; 1985 to 1987
Northern Engineering and Testing, Geotechnical Project Engineer, 1984 to 1985
Terratech, Inc., Staff Engineer, 1978 to 1981

REPRESENTATIVE PROJECT EXPERIENCE (Following listing is not exhaustive)

- Oversaw investigation, developed remedial options and directed remedial design and construction for interim coal tar removal system from a confined aquifer; coordinates completion of RI/FS for recently listed NPL site, former manufactured gas plant and wood treatment site; Ashland, Wisconsin.
- Coordinated investigation and developed remedial options for a former manufactured gas plant site currently used as a bulk propane distribution facility. Marshfield, Wisconsin.
- Performed research and provided expert testimony about the fate and transport of gasoline contaminants released from underground storage tanks allegedly contaminating a private residence.
- Coordinated and implemented environmental due diligence in preparation for acquisition for poultry processing operations at 90+ facilities.

- Provided expert testimony at an arbitration hearing on the validity of long-term remedial costs for a landfill (Superfund site) in southeastern Wisconsin.
- Developed remedial options for several manufactured gas plant sites; New York and Pennsylvania.
- Developed remedial options to expedite closure at a plating facility site contaminating groundwater with chromium.
- Evaluated applicability of past and future costs to validate insurance claims for remedial action at several landfill sites.
- Provided research and expert testimony at deposition for a named party at a Superfund site identifying other PRPs from individual waste stream analyses.
- Directed ROD implemented remedy including a gas extraction system upgrade and point-of-entry water filter installations for private homes, municipal sanitary landfill; Hudson, Wisconsin. Included expert testimony at trail.
- Provided expert testimony at deposition for a machine parts manufacturer evaluating the identification of manufactured gas plant waste disposed on their property; Milwaukee, Wisconsin.
- Provided expert testimony at trial for a paper company providing alternative water supplies for private residences affected by groundwater contamination from an industrial landfill; Eau Claire, Wisconsin.
- Developed strategy for investigating and providing cleanup options for dry-cleaning sites; Stevens Point, Wisconsin.
- Provided Agency negotiation, consultant review and oversight of an investigation and remedial options analysis for an abandoned sanitary landfill; Rice Lake, Wisconsin.
- Directed remedial design and remedial action oversight including final cover and landfill gas control, for an abandoned municipal waste landfill; Wausau, Wisconsin.
- Directed remedial design activities, including final cover and landfill gas control, for an abandoned municipal waste landfill; Rhinelander, Wisconsin.
- Performed a groundwater assessment, negotiated Agency approval for a selected remedial option, and directed construction management of a leachate extraction system for a paper waste landfill; Eau Claire, Wisconsin.
- Directed preparation of design plans and specifications, and construction management for remediation of 200,000 cubic yards of mining wastes under the Wisconsin Environmental Repair Program; Mineral Point, Wisconsin.
- Directed work plan development, negotiated USEPA approval, and directed the investigation for an abandoned landfill (NPL site); Tomah, Wisconsin.
- Oversaw design and construction of a landfill gas extraction system for an abandoned sanitary landfill; Tomah, Wisconsin.
- Directed investigation and remedial design activities for groundwater contamination from a former truck-trailer manufacturing operation; Edgerton, Wisconsin.
- Provided expert testimony at trial for food processing company siting a solid waste disposal facility.
- Provided expert testimony at deposition for a defendant for insurance claims at a foundry waste site (contaminated with lead); Milwaukee, Wisconsin.
- Prepared and implemented USEPA-approved RCRA facility investigation work plan for a hazardous waste incinerator (CWM Chemical Services); Chicago, Illinois.
- Directed preparation of Plan of Operation for a 3.5 million cubic yard sanitary landfill, including expert testimony before the Waste Facility Siting Board; Madison, Wisconsin.

- Directed preparation of plans and specifications for landfill cover restoration, state Superfund site; Madison, Wisconsin.
- Directed a remedial investigation and feasibility study for groundwater remediation options for an abandoned landfill; Dane County, Wisconsin.
- Directed remedial investigation for a former wood treatment (creosote) facility; Reed City, Michigan.
- Negotiated language for a voluntary consent order and directed investigation for a landfill remedial investigation (PRP group); Madison, Wisconsin.
- Coordinated design and construction of a landfill gas extraction system; Madison, Wisconsin.
- Directed preparation of a Feasibility Study and hydrogeologic assessment for a 1.5 million cubic yard industrial landfill; Wisconsin.
- Coordinated investigations and developed remediation options for several abandoned city sanitary landfills; Madison, Wisconsin.
- Developed a Feasibility Study for a 4 million cubic yard sanitary landfill, and provided expert testimony at a contested-case hearing; Madison, Wisconsin.
- Supervised subsurface investigations and prepared recommendations for remediation of two chlorinated hydrocarbon spill sites; Wisconsin manufacturing facilities.
- Supervised subsurface investigations and prepared hydrogeologic reports for several closed municipal landfill sites; Madison, Wisconsin.
- Prepared RCRA facility investigation work plan for a large military defense contractor (Hamilton Standards); Windsor Locks, Connecticut.
- Supervised investigations and developed remedial designs for several tank release sites; Wisconsin and Michigan.
- Developed remediation options for PCB-contaminated soils at an aluminum manufacturing plant; Kentucky.
- Coordinated investigation and developed design for a large demolition waste landfill facility; Portage County, Wisconsin.
- Developed an environmental and economic assessment for a county siting a hazardous waste facility; Minnesota.
- Prepared closure verification report for hazardous waste handling facilities in Wisconsin (APV Crepaco) and Illinois (Chemical Waste Management).
- Prepared feasibility/plan of operation report for a PCB transformer salvage facility; Juneau, Wisconsin.
- Designed a vacuum extraction system for remediation of an underground gasoline spill at a service station; Madison, Wisconsin.
- Designed and supervised construction of clay-lined earthen impoundments with dewatering facilities for foundry process sludge for a large industrial foundry facility; Defiance, Ohio.
- Devised geotechnical testing programs of various waste materials generated from paper manufacturing processes.
- Provided geotechnical analysis and recommendations for repair of a failure in a clay liner sidewall for a sanitary landfill; Minneapolis.
- Designed and implemented a modified multi-unit triaxial device to study the effects of leachate permeants on clay soils.
- Designed and provided construction documentation, kiln dust disposal facility; Alpena, Michigan.
- Designed and provided construction documentation, sanitary landfill; Minneapolis.

- Designed and provided construction documentation, foundry waste landfill; Milwaukee.
- Performed hydrogeological assessment of a solvent spill for an underground storage tank; South Bend, Indiana.
- Determined stability and projected settlements of embankments for bridge foundation; Idaho.
- Designed foundation and retaining structure recommendations for various commercial, industrial and transportation facilities; Idaho, Oregon and Washington.
- Designed foundation systems for residential, commercial and industrial buildings constructed on problem soils; San Francisco Bay area.
- Developed recommendations for the repair of residential structures damaged by soil expansion and settlement; San Francisco Bay area.
- Analyzed static and dynamic seacliff erosion and provided setback recommendations for a coastal development; Aptos, California.

PUBLICATIONS AND PRESENTATIONS

Author, "Characterization and Remedial Action at a Former MGP Adjacent to a Former Wood Treatment Operation," Gas Technology Institute Site Remediation Technologies Conference, 2000.

Co-author, "Isotopic Identification of the source of Methane in Subsurface Sediments of an Area Surrounded by Waste Disposal Facilities," in Applied Geochemistry, USGS, 1998.

Co-author, "Groundwater Remediation at a DeInk Landfill," TAPPI Environmental Conference, 1994.

Author, "Isotope Aging to Determine Methane Gas Sources, Geological Society of America, National Conference, 1992.

Author, "Current Status of Environmental Assessments," Government Institutes Seminar, Madison, 1992.

Author, "RCRA Corrective Action – 1990," paper presented to the Minnesota State Bar Association, Minneapolis, 1990.

Author, "Investigation and Remediation of a Printing Solvent Release," paper presented at the short course Detection and Corrective Action for Leaking Underground Storage Tanks, Department of Engineering-Professional Development, University of Wisconsin, Madison, 1989.

Co-author, "Case Studies in Constructive Use of Foundry Wastes for Landfill Construction," paper presented at the American Foundrymen's Society Casting Conference, 1987.

Author, "Moisture and Saturation Effects on Hydraulic Conductivity Testing," paper presented at the ninth annual Madison Waste Conference, 1986.

Co-author, "Use of Foundry Quenched Slag - Drainage Medium," presented at the 1986 Madison Waste Conference.

Weldon S. Bosworth, Ph.D.

Senior Scientist

AREAS OF EXPERTISE

- Contaminated Sediment Transport and Fate
- Ecological Risk Assessments
- Natural Resource Damage Assessment

EDUCATION

Ph.D. Concentration in Marine Ecology, 1976, Oregon State University

Master of Science in Zoology, 1969, University of New Hampshire

Bachelor of Arts in Zoology, 1964, University of New Hampshire

REGISTRATION

Professional Biologist, British Columbia, # 1230

PROFESSIONAL HISTORY

URS Corporation (formerly Dames & Moore), Senior Consultant, 1994-present.

Balsam Environmental Consultants, President and Senior Consultant, 1986-1994.

Normandeau Associates, Inc., President, Executive Vice President, Vice President of Operations, and Project

REPRESENTATIVE EXPERIENCE

Dr. Bosworth is a Senior Scientist with URS. He has over 30 years of consulting experience in evaluating environmental impact and working with clients to develop strategies for site remediation. This work has included studies for the siting and operation of major facilities as well as fate and transport studies for a variety of contaminants in aquatic and marine environments. Dr. Bosworth also conducts ecological risk assessments and Natural Resource Damages Assessments and develops and negotiates site-specific environmental cleanup criteria for contaminated sites. He has been involved in a number of large projects dealing with the management or remediation of contaminated sediments or dredge materials.

Dr. Bosworth has negotiated numerous scopes of work for environmental studies with state and federal regulatory agencies and has provided expert testimony on environmental impact at over a dozen regulatory hearings at state and federal levels as well as for cost recovery litigation. He has also made project presentations and moderated panels at various public meetings.

Dr. Bosworth was a member of and past Chair of the Scientific Advisory Committee of the U.S. EPA's Hazardous Substances Research Center South/Southwest, a consortium of universities led by Louisiana State University which conducts exploratory research in issues dealing with contaminated sediments and dredge materials.

Before joining URS, Dr. Bosworth was one of the founders of and President of Balsam Environmental Consultants, Inc., an environmental consulting company specializing in hazardous waste site investigations, environmental impact evaluations and wetlands restoration.

PROJECT RESPONSIBILITIES

- Principal Scientist and Ecological Risk Assessor to Xcel Energy for the Ashland/NSP Site in Ashland, WI. Sediment in area offshore from historical MGP plant is contaminated with elevated levels of PAHs. Responsibilities include supporting project team in evaluation of EPA contractor's ecological risk assessment and providing direction in issues dealing contaminated sediment fate and transport. Currently part of a multiple stakeholder team developing a Baseline Problem Formulation for future remedial investigation work. Participated in presentation to EPA National Contaminated Sediments Technical Advisory Group.

- Principal Scientist and Risk Assessor to ConocoPhillips for sites in Weymouth, MA. Risk assessment being conducted

Manager, 1972-1985.

AFFILIATIONS

Past Chair and Member, Scientific Advisory Committee of the Hazardous Substance Research Center/South and Southwest, 1992-2002.

Member, Society of Environmental Toxicology and Chemistry 1998-Present.

Member, Marine Studies Curriculum Advisory Committee, Southern Maine Vocational Technical Institute, 1979-1980.

Invited member to NOAA North and Mid-Atlantic Region Conference on Marine Pollution Studies, 1980.

Executive Board Member, New England Estuarine Research Society, 1976-1980.

Participated in OCEANLAB (undersea laboratory) workshop sponsored by New England Marine Advisory Service, 1976.

under Massachusetts Contingency Plan. As part of evaluation of sediment quality in Weymouth Neck Region, conducted PAH forensic analysis. Results indicated predominantly low temperature pyrogenic sources of PAHs in the nearshore sediments.

- Principal Scientist and Project Manager to Union Carbide for site in Ponce, Puerto Rico. Work involved developing work plan for sampling PAH-impacted sediments in former discharge. A management-level ecological risk assessment was also conducted to develop alternative action levels for cleanup of PAHs in order to guide remedial decisions.

- Principal Scientist to AVX Corporation for an independent evaluation of a U.S. EPA feasibility study at New Bedford Harbor Superfund Site. Included assessments of environmental and transport issues related to Natural Resource Damages issues and site remediation. Developed recommendations to address potential adverse impacts of PCB and heavy metals contamination in the estuarine sediments of the harbor. Provided management of, and collaborated with a team of nationally recognized PCB experts who evaluated PCB fate and transport, sediment quality criteria, toxicology, ecological risk, epidemiology, etc. As an alternative to dredging of over one hundred acres of estuary a Remedial Action Plan was developed that involved alternative cleanup levels and in-situ sub-aqueous capping of approximately 50 acres of contaminated sediment in shallow Upper Estuary of New Bedford Harbor. In addition a mitigation plan for restoration of 13-acre salt marsh potentially affected by site remediation was developed. Evaluated apportionment of damages and remediation costs of various PRPs and third parties.

- Principal Scientist and Project Coordinator for Operable Unit 2 of Sullivan's Ledge Superfund Site in New Bedford, Massachusetts. Addressed Natural Resource Damages and Ecological Risk Assessment issues for Middle Marsh. Evaluated potential effects of PCB in wetland site. Provided litigation support for and participated in negotiations with other parties on allocation and cost issues. This includes presenting an alternative limited action strategy for leaving PCBs in place rather than destroying valuable wetland area. Negotiated Statement of Work, managed Pre-Design and remedial design studies.

- Senior Consultant and Project Manager to Union Carbide (now Dow Chemical) for site in Belleville, Ontario. Evaluated alternatives for site remediation and conducted a Level I Ecological Risk Assessment of potential impacts of PCB and other constituents in a Lake Ontario wetland. Evaluated comparative impacts of excavation versus monitored natural recovery of PCB wetlands. This Risk Assessment was conducted following Ontario Provincial guidelines. A natural attenuation strategy for the wetlands was approved by the Ontario Ministry of the Environment.

- Senior Consultant for an ecological risk assessment for evaluating potential effects of PCB in wetlands and Mystic River, Medford, MA. Involves evaluating potential for natural attenuation through burial and biodegradation. Risk assessments being conducted under the Massachusetts Contingency Plan protocol.

- Senior Consultant for an ecological risk assessment for evaluating potential effects of PCB and pesticides in wetlands and ponds of Alcan Rolled Products Company in Oswego, New York. Involves evaluating potential for natural attenuation through burial and biodegradation. PCB congener vertical distribution and toxicity equivalency is being addressed.

- Co-Principal Investigator with Drs. Louis J. Thibodeaux and Danny Reible, Louisiana State University, for technology transfer of methodologies for in situ capping of contaminated bed sediments. A workshop was conducted that brought together selected members of the research, regulatory and consulting engineering communities on a national level. The purpose of this workshop was to develop a common perspective of the state of the practice, identify and discuss technical issues that need solution and develop an action plan to address these issues. The results of this workshop was published and incorporated into an Internet site.

- Principal Scientist to Tyco Suppression Systems-Ansul, Marinette, WI for site adjacent to Menominee River. Prepared baseline ecological risk assessment for evaluation of effects of arsenic in sediments of Menominee River to invertebrate, fish and wildlife receptors. Identified different species of inorganic and methylated arsenic species to differentiate their respective effects. Work has included sediment characterization, sediment bioassays and comprehensive benthic community characterization.

- Principal Scientist and Project Manager for a Baseline Ecological Risk Assessment for Hercules Chemical in Parlin, NJ. The objective of this study was to develop risk-based cleanup criteria for DDT in Brook 3 where DDT manufacturing by-products had historically been discharged. The assessment has involved evaluation of site-specific exposure pathways to receptors found in the area and estimating levels of DDT in sediment and surface water that would be protective of these receptors. Further work is presently being conducted to characterize nature and extent as well as potential risk from DDT in sediments in the South River into which Brook 3 discharges. A baseline ecological risk assessment currently is being conducted. Supporting work has included sediment characterization and benthic and fish community characterization.

- Principal Scientist to ConocoPhilips, Inc. for conducting an evaluation potential impact to intertidal and subtidal sediments near Weymouth Neck Massachusetts from contaminants associated with former fertilizer operation. Potential contaminants included arsenic, copper, zinc, and PAHs.

- Senior Consultant to CITGO Petroleum Corporation for a site in Sulfur, LA along the Calcasieu River Estuary. Independently evaluated the fate and transport of sediment-associated chemicals in Calcasieu Estuary. Critically reviewed preliminary Natural Resource Injury Evaluation prepared by NOAA. Monitoring and providing critical review of Calcasieu Estuary RI/FS investigations for CITGO.

- Principal Scientist for critique of a Natural Resources Damages Assessment of the Southern California Bight. Provided litigation support and expert opinion on issues related to fate, transport and ecological effects of DDT and PCB associated with the sediment bed on the Palos Verdes Shelf.

- Principal Scientist and Project Manager to Nexen (formerly Canadian Occidental Petroleum Ltd.) for site in Squamish, BC. Completed human health and ecological risk assessment for assessing the potential effects of chlor-alkali and chlorate plant operations on Howe Sound and surrounding upland areas. Risk assessment evaluated the potential effects from several chemicals, including, mercury and chromium. Provided guidance to Nexen for management of contaminated sediments and ground water. Conducted sediment toxicity bioassays and benthic community characterization. Provided expert testimony before BC Environmental Appeals Board on aspects of the project.

- Principal Scientist and Senior Peer Reviewer to BCMWLAP contract managed by Golder Associates for screening ecological risk assessment evaluating the potential impacts from Britannia Mine on Howe Sound intertidal and subtidal ecosystems.

- Principal Scientist to Domtar, Inc. for evaluation of sediment contamination at Vancouver Shipyard. Work consisted of critical review of historical reports and development of an expert opinion.

- Principal Scientist and Project Manager to Dow Chemical Canada, Inc. for site in Sarnia, Ontario. Worked with Dow to help develop strategy for addressing impacted sediments in St. Clair River along Dow waterfront. Developed work plan for sampling sediments to acquire data to support an evaluation of remedial alternatives for former Dow Outfall Area. Pilot dredging project for a portion of the St. Clair using TMT® dredge has been implemented and Phase I operational dredging is now being conducted. Currently working with Ontario MOE and Environment Canada on behalf of Dow to develop risk assessment guidance for the management of contaminated sediments in other areas of the St. Clair River.

- Project Manager for evaluating the environmental impact of various project alternatives for a 6-acre Portsmouth, New Hampshire port facility expansion on marine and wetland communities in the Piscataqua River. Project lead for development of mitigation plans, significant regulatory negotiations, and successful permitting effort including U.S. Army Corps of Engineers Section 10 and 404 permits for dredging and ocean disposal, Coastal Zone Management Consistency, and Section 401 Water Quality Certification. Marine terminal was successfully permitted and construction was initiated in 1996.

- Project Manager for a Lake Ontario shoreline protection study for the U.S. Army Corps of Engineers

- Officer-in-Charge for several projects at various New England harbors to provide information on the environmental impacts of dredging and spoil disposal for the U.S. Army Corps of Engineers.

- Senior Consultant and Risk Assessor for the GE Medford, MA site. Responsibilities have included preparation of a Stage I Ecological Risk Screening (under the Massachusetts Contingency Plan) addressing PCBs in the sediments of an aquatic area contiguous to the Mystic River.

- Principal Scientist providing litigation support and expert testimony for Natural Resources Damages claims for confidential client in Commencement Bay.

- Senior Consultant and Risk Assessor to General Electric for investigations at GE Schenectady Plant. Responsibilities have included development of a proposal for a habitat enhancement and natural attenuation plan in lieu of RCRA cap for 200 acre landfill on site. This work has also included the preparation of a screening ecological risk assessment.

- Senior consultant to Bethlehem Steel Corporation, Lackawanna, NY. Developed a Tier 2 ecological risk assessment of former coke and steel manufacturing operations site located on Lake Erie. Considered potential impacts on both terrestrial and aquatic receptors from various constituents of potential concern, including PAHs, resulting from those operations.

- Project Manager for Limited Ecological Risk Assessment for McKin site in Gary, Maine. This project evaluated the potential risk of trichloroethylene and 1,1,1-trichloroethane in ground water to aquatic receptors in a nearby stream. An instream benthic macroinvertebrate evaluation was also conducted following Maine Department of Environmental Protection protocols.

- Project Manager for a large, multi-year, multidiscipline baseline environmental study in coastal waters of New Hampshire for Seabrook Station, a nuclear generating station. Included design, development and evaluation of a sampling program for all biological communities, and collaboration on design of physical oceanographic studies. Supervised installation and maintenance of over 40 in-situ instruments in nearshore ocean environment, negotiated with state and federal regulatory agencies, and provided expert testimony on environmental impact at over a dozen regulatory hearings.

- Project Manager for a Method 2 Modification to Massachusetts Contingency Plan Standards. This project involved the use of a ground water transport model to predict concentrations of cyanide in ground water and extrapolate potential effects to downstream surface water receptors.

- Project Manager for a wetlands functional evaluation used as part of a Stage 1, Method 3 Environmental Assessment conducted in accordance with the Massachusetts Contingency Plan.

- Principal-in-Charge for an ecological risk assessment under CERCLA for a municipal landfill in Vermont. Identified ecological receptors that may be exposed to chemicals associated with landfill seeps, quantified levels of exposure and developed information on toxic effects of chemicals to characterize risks to the ecosystem.

- Officer-in-Charge for studies of water quality, benthos, and aquatic and terrestrial habitats for FERC Exhibit E for proposed "Big A" hydroelectric facility. Included developing scope of work, reviewing and approving study plans and technical reports, and using Habitat Evaluation Procedures (HEP) for developing mitigation plans.

- Officer-in-Charge of physical and biological studies of OCS test site prior to leasing of offshore areas for exploratory drilling, George's Bank, Baltimore Canyon, Georgia Embayment.

- Officer-in-Charge of development of a candidate environmental impact study for a proposed dredging program at the Portsmouth Naval Shipyard in Kittery, Maine. Involved assessing dredging impacts as well as evaluating and selecting both offshore and upland spoil disposal sites.

PUBLICATIONS AND PRESENTATIONS

- Bosworth, W.S. and Turner, R.R. 2001 The Fate and Transport of Mercury in a Canadian Fjord. Presented at SETAC 2001.

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